Thesis for the Degree of Ph. D

THE RELATION OF SPATIAL PERCEPTION

AND ACCURACY OF MOVEMENT

TO

ENGINEERING ABILITY

BY

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The Relation of Spatial Perception and Accuracy of Movement to Engineering Ability

PREFACE.

The investigation of the relation of Spatial Perception and Accuracy of Movement to Engineering Ability was suggested to the author in a conversation with a member of the staff of the National Institute of Industrial Psychology. In the course of investigations by the N.I.I.P. tests of Space Perception are used from time to time. It occurred to the author that if there is a relation between Spatial Perception and Accuracy of Movement and Engineering Ability, tests for Spatial Perception and Accuracy of Movement might prove to be of considerable value, in conjunction with methods at present adopted, in selecting suitable candidates for apprentices in the engineering trades.

At present there is no definite method of selecting apprentices for engineering. Some engineering firms choose apprentices in a haphazard manner on the basis of age and physical fitness. Others again enquire more particularly into early training, school records etc., before making a selection. Others engage apprentices for a short probationary period at the end of which time they may or may not be indentured as apprentices according to the satisfaction or otherwise they give during this probation. None of these methods is entirely satisfactory, for in spite of the utmost care in selection in any of the ways mentioned there are always some of the apprentices who fail to become efficient engineers and who have little hope of success if they continue in that particular branch of industry. Now if there were some tests of specific abilities with an esta-

blished relation with engineering ability, the application of such tests at the time when apprentices are being selected might prove to be a valuable help in selection, and thereby the number of failures at the end of apprenticeship might be reduced with a consequent saving of time and economic advantage both to employers and to the youths concerned. To many youths it may mean tragedy and disaster to make the discovery at the end of their apprenticeship that they will probably never be successful in the trade they have spent some years endeavouring to learn.

INTRODUCTION.

It is necessary at the outset to indicate the ground covered by this investigation and to indicate the limits within which it is confined.

First of all it is necessary to give some information concerning the subjects who have been tested. These are divided into three distinct groups.

(1) A random group of engineering apprentices engaged serving their apprenticeship in an engineering work.
(2) A group of engineering students in a Technical Institution taking an engineering course which permits of an estimate of engineering ability being made.
(3) A non-engineering group of students in the same Technical Institution as those in group 2.

Group (1) the author calls a random group because nothing was done in the way of picking out or selecting subjects in this group. Apprentices were taken from the following departments of the works:- the Machine Shop, the Fitting Shop, the Pattern Shop, the Tool Room, the Drawing Office, the

Brass Shop, and the Transformer and Winding Shops of the Electrical side. Again these apprentices were at various stages of their apprenticeships-from the first to the fifth year. The method adopted by the author in compiling the group was to ask the foreman of one of the shops to send apprentices to do the tests and to allow the foreman to send any apprentices he cared to send. In examining the group the author found seven subjects were in the first year of their apprenticeship, four in the second year, seven in the third year, seven in the fourth year and five in the fifth year. (See footnote)

Group (2) is composed of students who had set out on a course of study with a view to obtaining the diploma of the college in engineering. The tests were performed when they were in the first year of their course and all of the subjects in this group took the classes in workshop practice and patternmaking during the summer following their first year course. Some of them had had previous engineering experience but many had not up to the time of testing been working in engineering works.

Footnote.

Permission had been granted to the author by the Managing Director of the works to carry through the tests with the apprentices, and the Works Superintendent gave every possible facility to the author by instructing the foremen to arrange for the apprentices being sent when requested. The apprentices also were given the opportunity of declining to perform the tests if they wished, but all willingly consented.

Group (3) the author calls a non-engineering group of students as it is made up of students who had not had any engineering experience and who did not take the workshop and pattern-making courses, and others who were taking non-engineering courses such as Mining, Building Chemistry etc. The author would have liked to have tested a group of subjects known to have no engineering ability — if such a group were obtainable. It would seem an almost impossible group to bring together on account of the difficulty of determining the absence of engineering ability in any particular subject. From this point of view Group (3) appeared to be the "next best". ~~but~~ In it there are probably a number who may become engineers but at the time when the tests were performed this could not be determined.

The tests also may be divided into groups.

(1) An Intelligence Test

(2) Tests of Spatial Perception

(3) Tests of Accuracy of Movement

(4) Tests of Engineering Ability.

It was thought desirable that all subjects should have an Intelligence Test. Reference to such a test might possibly explain any abnormal results in the other tests and in any case the correlation between Intelligence and Engineering Ability, Spatial Perception and Accuracy of Movement will be at least of interest.

All the subjects performed the Intelligence Tests as a group test. Group (1) for the purpose of the Intelligence test was taken in five groups of six each on account of the difficulty of getting thirty apprentices out of the works for the required period at the same time. The circumstances under which the test was performed were as far as possible similar, for each group met at the same hour 10 a.m., in the

library of the works on successive days till all had completed the test. The author supervised the test himself and only the author and the subjects were present during the tests. Groups (2) and (3) carried through the tests in three groups during their first year as students; on each occasion the same class room was used and the same time in the forenoon, 10.15 a.m. was chosen for the test. The test was supervised by the author and no one was present but those performing the tests. All subjects were willing to perform the tests as an opportunity was given to all, to decline if they desired to do so.

The Tests of Spatial Perception and Accuracy of Movement were done as individual tests, only the author and the subject being present, and complete privacy was maintained during the test. In the case of the students in Groups (2) and (3) the tests were performed in a private room and in the case of the subjects in Group (1) they were performed in the library of the works which was at the disposal of the author for this purpose.

With regard to Engineering Ability, this has been graded in the case of the group of engineering apprentices, Group (1), by means of a conference between the Works Superintendent and the respective foremen under whom the apprentices worked. In the works where the investigation was partially carried out, the Works Superintendent has a record kept of each apprentice throughout his apprenticeship and from this record together with a special enquiry made on behalf of the author, the Works Superintendent was able to give a comparatively accurate grading of Engineering Ability for this particular group. The foremen were not aware at the time the enquiry was made for what purpose the information about the apprentices was required so that it is probably free from any bias so far as the investigation is concerned.

With regard to Group (2), the group of engineering students whose Engineering Ability is estimated, the estimate of engineering ability has been taken from the work done by each of them in the workshops – turning, fitting and patternmaking, and in the drawing office. Here again as the subjects were unaware of the investigation in carrying through their work in the various classes, the estimate is not influenced by the knowledge that a test was being made, and the performance is a normal one.

For Group (3) there is no test of engineering ability and so the correlations in this group are between Intelligence, Spatial Perception and Accuracy of Movement only.

It is necessary at this point to define the limits of the terms of the investigation. Spatial Perception is taken to mean the cognition or apprehension of figure —shape size and volume—position and direction. The mental processes involved are on the perceptual level chiefly but may involve the conceptual level as well, as in the cubebuilding test where a large cube has to be built up from a number of small cubes.

Accuracy of Movement is limited to movement of hands and arms in particular directions and it is difficult to separate out movement, space judgment, and estimation of distance or space moved; this is especially true since the subject does some of the tests blindfolded and in such circumstances it is difficult to determine whether the subject is doing the tests by method of accuracy of movement or by space judgment based on muscular strain or by comparison of positions in space in which the time factor is taken into account. Reference to the tests performed will make this clear.

Engineering Ability in its widest application means skill in engineering generally and this may be in any

direction of engineering whatever, in design, organisation or salesmanship. The sense in which the term is used in the investigation is much more circumscribed and means, engineering ability as shown in the engineering workshops in the case of Group (1) of engineering apprentices; and engineering ability as shown in workshop practice, patternmaking and engineering drawing in the case of Group (2) of engineering students.

THE TESTS.

The following were the tests used in the investigation.

(1) INTELLIGENCE TESTS.

(2) TESTS OF SPATIAL PERCEPTION

a) A Cube Building Test

b) Formboard Tests (4 in all).

c) A Strip-building Test.

(3) TESTS FOR ACCURACY OF MOVEMENT (2 tests)

(4) TESTS OF ENGINEERING ABILITY.

a) Workshop tests in Turning and Fitting.

b) Patternmaking.

c) Engineering Drawing.

INTELLIGENCE TESTS

The test used was Group Test -No. 33 compiled by the National Institute of Industrial Psychology. (copy supplied) It consists of five tests each containing a number of short problems with a time limit of 3 or 10 minutes according to the test, the time allowed being shown at the head of the test. Full instructions are printed on the outside of the cover and in doing the test no writing was required, the answer being printed; The subject was required to pick out and underline the correct answer. The tests are (a) Opposites, (b) Analogies, (c) Mixed Sentences, (d) Completing Sentences and (e) Reasoning. The copy supplied is completed with notes and scoring written on outside of the copy.

№ 11088
KEY COPY.

National Institute of Industrial Psychology.

SCORING:- ONE MARK FOR EACH CORRECT UNDERLINING. (UNLESS OTHERWISE STATED.)

Group Tests—Series 33.

GENERAL INSTRUCTIONS.

NO MARK ALLOWED WHERE MORE THAN ONE ANSWER IS UNDERLINED

DO NOT TURN OVER THIS PAGE UNTIL YOU ARE TOLD.

MAX SCORE FOR WHOLE TEST = 193

Fill in the following at once :—

Name : Surname..... Christian Name .....

Age : ..... Years, ... Months.

Date : ..... Time : .....

School : ..... Class, Form or Standard.....

1. **Read this page carefully. Do not look at any other page until you are told.**

2. The question paper contains five tests, each consisting of a number of short problems. The time allowed for each test (either 3 or 10 minutes) is shown at the head of the test.

3. When the examiner says " Turn over ; first test : Opposites," turn over immediately to the following page, and work Test I., according to the directions which you will find at the top. When three minutes are over, a similar signal will be given ; you must then turn over to Test II. And so for the remaining tests

4. The examiner will call out the name of each test as you are to begin it ; see that you are doing the right test. But do not begin the next test until the examiner tells you to.

5. Notice that some tests occupy two or three pages. Do not wait to be told to begin the second or third page with these.

6. In answering the questions there will be **nothing to write.** You will have to pick out the correct answer, and **underline** it only. Use pencils only. No ruler or india-rubber is allowed.

7. **You are unlikely to be able to finish the whole of any test.** Work as fast as you can. **Do not lose time** by spending too long over any one problem.

TEST I. OPPOSITES.

(*Time allowed*, 3 *minutes*.)

Where the two words mean the same or nearly the same draw a line under SAME.
Where they mean the opposite or nearly the opposite, draw a line under OPPOSITE.
Where you do not know which they are, draw a line under UNKNOWN.

EXAMPLES :—

Rich ... Poor ... SAME ... OPPOSITE ... UNKNOWN.

Big ... Large ... SAME ... OPPOSITE ... UNKNOWN.

1.	Dry	...	...	Wet	...	...	SAME	...	OPPOSITE	... UNKNOWN 1
2.	Hot	...	...	Cold	...	...	SAME	...	OPPOSITE	... UNKNOWN 2
3.	Sick	...	...	Ill	...	...	SAME	...	OPPOSITE	... UNKNOWN 3
4.	Lost	...	...	Found	...	...	SAME	...	OPPOSITE	... UNKNOWN 4
5.	Kind	...	...	Cruel	...	...	SAME	...	OPPOSITE	... UNKNOWN 5
6.	Dirty	...	...	Unclean	...	...	SAME	...	OPPOSITE	... UNKNOWN 6
7.	Asleep	...	...	Awake	...	...	SAME	...	OPPOSITE	... UNKNOWN 7
8.	Pull	...	...	Push	...	...	SAME	...	OPPOSITE	... UNKNOWN 8
9.	Scarce	...	...	Rare...	...	...	SAME	...	OPPOSITE	... UNKNOWN 9
10.	Tender	...	...	Tough	...	...	SAME	...	OPPOSITE	... UNKNOWN 10
11.	Preserve	...	...	Destroy	...	...	SAME	...	OPPOSITE	... UNKNOWN 11
12.	Blunder	...	...	Mistake	...	...	SAME	...	OPPOSITE	... UNKNOWN 12
13.	Belief	...	...	Doubt	...	...	SAME	...	OPPOSITE	... UNKNOWN 13
14.	Haughty	...	...	Arrogant	...	...	SAME	...	OPPOSITE	... UNKNOWN 14
15.	Adversity	...	...	Prosperity	...	...	SAME	...	OPPOSITE	... UNKNOWN 15
16.	Droll	...	...	Odd	...	...	SAME	...	OPPOSITE	... UNKNOWN 16
17.	Abandon	...	...	Discard	...	...	SAME	...	OPPOSITE	... UNKNOWN 17
18.	Cultivated	...		Wild	...	...	SAME	...	OPPOSITE	... UNKNOWN 18
19.	Permissible	...		Prohibited	...	...	SAME	...	OPPOSITE	... UNKNOWN 19
20.	Backwards	...		Reversed	...	...	SAME	...	OPPOSITE	... UNKNOWN 20
21.	Slow	...	...	Tardy	...	...	SAME	...	OPPOSITE	... UNKNOWN 21
22.	Cancel	...	...	Annul	...	...	SAME	...	OPPOSITE	... UNKNOWN 22
23.	Frank	...	...	Candid	...	...	SAME	...	OPPOSITE	... UNKNOWN 23
24.	Culpable	...	...	Innocent	...	...	SAME	...	OPPOSITE	... UNKNOWN 24
25.	Feasible	...	...	Practicable	...	...	SAME	...	OPPOSITE	... UNKNOWN 25

26.	Creditable...	...	Disreputable	...	SAME	...	OPPOSITE	...	UNKNOWN	26
27.	Slanting ...	...	Oblique ...	...	SAME	...	OPPOSITE	...	UNKNOWN	27
28.	Inanimate	...	Dead ...	...	SAME	...	OPPOSITE	...	UNKNOWN	28
29.	Indefinite ...	...	Vague ...	...	SAME	...	OPPOSITE	...	UNKNOWN	29
30.	Deprive ...	...	Restore ...	...	SAME	...	OPPOSITE	...	UNKNOWN	30
31.	Ratify ...	...	Confirm ...	...	SAME	...	OPPOSITE	...	UNKNOWN	31
32.	Inevitable	...	Avoidable ...	...	SAME	...	OPPOSITE	...	UNKNOWN	32
33.	Infamous ...	...	Notorious ...	...	SAME	...	OPPOSITE	...	UNKNOWN	33
34.	Precise ...	...	Erroneous ...	...	SAME	...	OPPOSITE	...	UNKNOWN	34
35.	Lasting ...	...	Transitory ...	...	SAME	...	OPPOSITE	...	UNKNOWN	35
36.	Sagacity ...	...	Imbecility ...	...	SAME	...	OPPOSITE	...	UNKNOWN	36
37.	Docile ...	...	Recalcitrant	...	SAME	...	OPPOSITE	...	UNKNOWN	37
38.	Malevolent	...	Propitious ...	...	SAME	...	OPPOSITE	...	UNKNOWN	38
39.	Enmity ...	...	Animosity ...	...	SAME	...	OPPOSITE	...	UNKNOWN	39
40.	Conclusive	...	Irrefutable ...	...	SAME	...	OPPOSITE	...	UNKNOWN	40
41.	Naive ...	...	Disingenuous	...	SAME	...	OPPOSITE	...	UNKNOWN	41
42.	Methodical	...	Capricious ...	...	SAME	...	OPPOSITE	...	UNKNOWN	42
43.	Relinquish	...	Cede ...	...	SAME	...	OPPOSITE	...	UNKNOWN	43
44.	Munificent	...	Parsimonious	...	SAME	...	OPPOSITE	...	UNKNOWN	44
45.	Inimitable...	...	Unique ...	...	SAME	...	OPPOSITE	...	UNKNOWN	45
46.	Ambiguous	...	Equivocal ...	...	SAME	...	OPPOSITE	...	UNKNOWN	46
47.	Lugubrious	...	Hilarious ...	...	SAME	...	OPPOSITE	...	UNKNOWN	47
48.	Disparaging	...	Derogatory	...	SAME	...	OPPOSITE	...	UNKNOWN	48
49.	Miscellaneous	...	Heterogeneous	...	SAME	...	OPPOSITE	...	UNKNOWN	49
50.	Satiety ...	...	Repletion ...	...	SAME	...	OPPOSITE	...	UNKNOWN	50

MAXIMUM 50.

TEST II. ANALOGIES.

(Time allowed, 8 minutes.)

In each question a fourth word is wanted which goes with the third word (in capitals) in the same way as the second word (in capitals) goes with the first. Look in the second line of each question for the word that is wanted ; and draw a line under it. **Do not write anything.**

EXAMPLES :—

GOOD is to BAD as WHITE is to
CLEAN, BLACK, WICKED, RED.

BAKER is to BREAD as TAILOR is to
TAILORESS, CAKE, MAN, CLOTHES.

1. FATHER is to MOTHER as HUSBAND is to
RED, WIFE, GREEN, BUSINESS.

2. UP is to DOWN as HIGH is to
LOW, BOOK, COAL, DIFFICULTY.

3. PRINCE is to PRINCESS as KING is to
DUCHESS, CROWN, QUEEN, ROYAL.

4. PARENT is to CHILD as MOTHER is to
WIFE, MAID, DAUGHTER, SERVANT.

5. FIRE is to HOT as ICE is to
CREAM, WATER, SOLID, COLD.

6. EAT is to BREAD as DRINK is to
DRUNKARD, THROAT, CUP, WATER.

7. SITTING is to CHAIR as SLEEPING is to
WALKING, TIRED, BED, DREAM.

8. JANUARY is to DECEMBER as SUNDAY is to
TUESDAY, MONDAY, SATURDAY, WINTER.

9. FLYING is to BIRD as CREEPING is to
AEROPLANE, SNAIL, GROUND, FLOWER.

10. TEARS are to SORROW as LAUGHTER is to
JOY, SMILING, CRYING, MISERY.

11. SIGHT is to PICTURE as HEARING is to
SONG, COLOUR, EAR, SEEING.

12. EGG is to BIRD as SEED is to
PLOUGHMAN, FOWL, PLANT, WHEAT.

13. REMEMBER is to PAST as ANTICIPATE is to
FANCY, FUTURE, FORGET, PRESENT.

14. BEAR is to CUB as DOG is to
CAT, SPANIEL, PUPPY, KITTEN.

15. FACT is to FICTION as HISTORIAN is to
HISTORY, BOOK, NOVELIST, MATHEMATICIAN.

16. BEAUTY is to ART as TRUTH is to
SCIENCE, MUSIC, ARTIST, LIAR.

17. ASLEEP is to AWAKE as DEAD is to
HEAD, CORPSE, ALIVE, MORTALITY.

18. FOOD is to MAN as FUEL is to
WOMAN, STEAM, ENGINE, VAPOUR.

19. SKY is to GROUND as CEILING is to
GAS, WALL, FLOOR, CHANDELIER.

20. SWEET is to HONEY as SOUR is to
SUGAR, SALT, VINEGAR, PEPPER.

21. HORSE is to MULE as DOCILE is to
RIDER, STUBBORN, DONKEY, MAN.

22. WHEN is to WHERE as TIME is to
HOW, WHY, SPACE, LENGTH.

23. MOTIVE is to METHOD as WHY is to
WHERE, MANNER, REASON, HOW.

24. CAUSE is to EFFECT as DISEASE is to
REASON, CONSEQUENCE, DEATH, LIFE.

25. THE DAY BEFORE YESTERDAY is to THE DAY AFTER TO-MORROW as SATURDAY is to
SUNDAY, MONDAY, WEDNESDAY, FRIDAY.

MAXIMUM 25.

TEST III. MIXED SENTENCES.

(Time allowed, 8 minutes.)

The words in each sentence below are mixed up. Think how the sentence would read if the words were arranged in the proper order. Then, if what the sentence means is TRUE, draw a line under "TRUE"; if what it means is NOT TRUE, draw a line under "FALSE"; otherwise, draw a line under "UNKNOWN."

EXAMPLES :—

a roses odour pleasant have ... TRUE ... FALSE ... UNKNOWN

freezes water hot when ... ... TRUE ... FALSE ... UNKNOWN

1. paper burn will ... ... TRUE ... FALSE ... UNKNOWN 1
2. land sail dry ships on ... ... TRUE ... FALSE ... UNKNOWN 2
3. read meant to be are books ... ... TRUE ... FALSE ... UNKNOWN 3
4. night sleep time is the at to best ... ... TRUE ... FALSE ... UNKNOWN 4
5. girls up men grow when become they ... ... TRUE ... FALSE ... UNKNOWN 5
6. year season winter the the is of coldest ... TRUE ... FALSE ... UNKNOWN 6
7. are there in three yard feet one ... ... TRUE ... FALSE ... UNKNOWN 7
8. parents disobey child a should always his ... TRUE ... FALSE ... UNKNOWN 8
9. seven twenty-five five are times ... ... TRUE ... FALSE ... UNKNOWN 9
10. happiness invariably source crime of is a ... ... TRUE ... FALSE ... UNKNOWN 10
11. caused by are disasters great sometimes accident... TRUE ... FALSE ... UNKNOWN 11
12. out manufactured are glass chalk iron and of principally ... ... TRUE ... FALSE ... UNKNOWN 12
13. deceptive occasionally extremely are appearances... TRUE ... FALSE ... UNKNOWN 13
14. pleasure innocence are and another with not one compatible ... ... TRUE ... FALSE ... UNKNOWN 14
15. annual week a once held celebration is an... ... TRUE ... FALSE ... UNKNOWN 15

16. of the friendship a person unhappy us makes ... TRUE ... FALSE ... UNKNOWN 16

17. rabbits exceedingly mice are and bold both ... TRUE ... FALSE ... UNKNOWN 17

18. heat solids necessary is to certain melt ... ... TRUE ... FALSE ... UNKNOWN 18

19. best form the and policy dishonesty infidelity ... TRUE ... FALSE ... UNKNOWN 19

20. sun moon the the are and from feet six other only distant each ... ... TRUE ... FALSE ... UNKNOWN 20

21. light dark clearly requisite artificial see is the to in TRUE ... FALSE ... UNKNOWN 21

22. bombs explosive revolvers all swords are gun-powder and ... ... TRUE ... FALSE ... UNKNOWN 22

23. possible live nourishment taking years without is to it for ... ... TRUE ... FALSE ... UNKNOWN 23

24. the the a of should weather yacht captain sailing always consider ... ... TRUE ... FALSE ... UNKNOWN 24

25. all all thieves murderers women men are are and TRUE ... FALSE ... UNKNOWN 25

26. assistance great attention close mistakes number decreasing of of the may in be ... ... TRUE ... FALSE ... UNKNOWN 26

27. some some some some all at nothing people pipes cigars cigarettes smoke ... ... TRUE ... FALSE ... UNKNOWN 27

28. there if doctors hospitals no or were die would more far people young ... ... TRUE ... FALSE ... UNKNOWN 28

29. infant youth man the are in of increasing order foregoing printed age correctly ... ... TRUE ... FALSE ... UNKNOWN 29

30. a inquest coroner's at held is as such an inquiry demand to law by supposed deaths are sudden TRUE ... FALSE ... UNKNOWN 30

MAXIMUM = 30.

TEST IV. COMPLETING SENTENCES.

(*Time allowed*, 10 *minutes*.)

Underline the word, phrase, or number, that makes the best sense, wherever there are three printed one above the other.

EXAMPLES :—

January months
1. Monday and Tuesday are years of the week.
Autumn days

fell cured
2. The man rode off his bicycle and broke his arm.
climbed changed

green green
1. Grass is wet but the sky is wet.
blue blue

kind always
2. A healthy child is often ill.
cruel seldom

young well
3. A middle-aged artist paints badly.
good sign-boards

yellow colours
4. Orange, potato and raspberry are all names of fruit.
lemon vegetables

dark dark the equator
5. It is light in the day-time, but it is light at noon.
fine fine night

street owed steal
6. I saw a begger in the hotel and showed him sixpence to sell some food.
parlour gave buy

condemn virtues themselves
7. How often do people praise in others the very faults they are guilty of perceiving.
profit serious pardoning

rich cottage like man
8. The poor man in his mansion is often far less happy and the poor woman in his hut.
happy home than landlord

Brown slowest
9. If Robinson runs faster than Jones, and Jones runs faster than Brown, then Smith runs fastest
Smith backwards
of the three.

seven words 1234567 6905678

10. The preceding groups of letters are identical ; 1234321 and 7543218.
following figures 8224338 1234321

hear station helpful telescope

11. In order to see clearly at a telephone it is unnecessary to use a telegraph.
speak distance rare microscope

Two

12. Three boys are standing in a line ; John is to the left of Henry ; William is to the left of John.
Four

John

Hence, Henry is in the middle.
William

a million four hands upon

13. Almost every man is born with long arms and two legs attached to his body, and a
every other two ears beneath

hands

pair of eyes to hear with.
ears

crooked

14. Three towns lie in a straight line. Norton is East of Melton ; Wilton is East of Norton.
curved

North

Hence, Melton is East of Wilton.
West

Friday before Thursday

15. If to-day were Saturday, then the day after to-morrow would be Tuesday.
Sunday preceding Wednesday

is a more beautiful metal

16. (*a*) Gold is more suitable for the coinage than iron because it is scarcer and so more valuable.
does not rust so quickly.

mountain-tops the sun seldom shines on them

(*b*) High valleys are covered with perpetual snow, because they are so near the clouds.
buildings the atmosphere is so cold

there wishes seeing officer

17. Such as the officer is such will be his enemies, and hoping that in this instance the man was
they men wishing enemy

not brave

a coward, we are very surprised to find the men were cowards likewise.
always enemies.

[Turn over now.

18. A man writing on January 1st, 1922, said: My sister, who died / was born / was married 1898 / on November 18th, 1858 / 1900 will be twenty-five / thirty-three / thirty-four years old next year / November. / month

19. It has been argued that Mahomed was both / either once an enthusiast or an ignoramus / impostor; and, were this true, those who / may / will deny that Mahomedannism / Christianity / he was an infidel / insincerity / enthusiast would be forced to conclude that he must / should / could not have been an impostor.

20. Nancy is the oldest / baby sister; when Jane tells Winnie to look after Nancy, Jane / Winnie generally refuses if Grace or Mary are in the house, because Mary / Winnie / Grace is Grace's pet sister and can also order Mary about just as Grace orders Jane about. Therefore, of the five sisters Nancy / Jane / Grace / Mary Winnie is probably the oldest; Nancy / Jane Winnie is probably the next; Nancy / Jane / Grace / Mary Winnie is probably the third; Nancy / Jane / Grace / Mary Winnie the fourth, and Nancy / Jane / Winnie the youngest. / Grace / Mary

MAXIMUM = 70

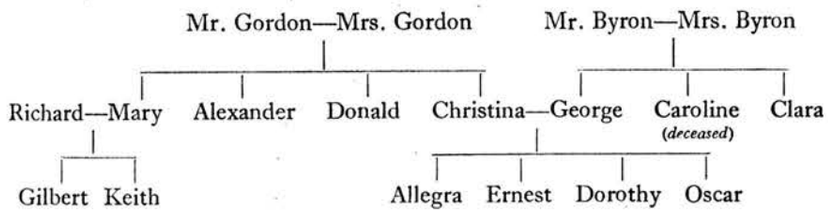
1898
1858
1900

TEST V. REASONING.

(*Time allowed*, 10 *minutes*.)

In each of the following problems, underline the word or words indicating the correct answers. Nothing is to be written.

(1—3) The following chart gives the complete pedigree of the families concerned :—



1. What relation is Richard to Christina ? Son, Cousin, Stepsister, Stepbrother, Brother-in-law ?
2. What relation is Oscar to Mr. Gordon ? Son, Grandson, Greatgrandson, Nephew ?
3. How many aunts living has Oscar ? One, Two, Three, Four ?

(4—6) Find in each set of five given on the right, two letters or numbers that suitably continue the series indicated on the left.

4. 30, 50, 70, 90.	100, 120, 130, 140, 110.
5. Z, A, Y, B.	Z, Y, X, C, D.
6. $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1.	2, 3, $1\frac{1}{2}$, $1\frac{3}{4}$, $1\frac{1}{4}$.

QUES 4-9
½ MARK FOR EACH CORRECT UNDERLINING.

(7—9) Underline in each row two words that do not belong to the same class or category as the rest :—

7. Hat, Head, Boot, Shoe, Stocking, Hand, Glove.
8. Oil, Quicksilver, Bladder, Lead, Boat, Cream, Cork.
9. Franc, Shilling, Rupee, Pound Sterling, Sovereign, Farthing, Penny.
10. Caloot is 50 miles due west of Balassa ; Balassa is 50 miles due north of Agra :—
    Is Agra (i) North-East, (ii) North-West, (iii) South-West, (iv) South-East, of Caloot ?
    (v) Or is it impossible to say without further information ?

(11—13) In each line below, imagine the words arranged in order of size or importance (without re-writing or numbering them) ; and then underline the middle word of the series as thus re-arranged :—

11. Twenty-two, fourteen, twenty, sixteen, eighteen.
12. Foot, inch, furlong, mile, yard.
13. Volume, letter, chapter, sentence, paragraph.

[Turn over now.

(14—15) In a certain territory 80 per cent. of the inhabitants were against German rule, and 60 per cent. were against French rule :—

14. Were there any against both French rule and German ?

ANSWER. (i) Yes ; (ii) No ; (iii) One cannot say without further details.

15. Were there any who were not against either ?

ANSWER. (i) Yes ; (ii) No ; (iii) One cannot say without further details.

16. Kenneth Digby was five days younger than Sir Thomas Browne ; and Digby was born on December 28th, 1605. In the year 1630 Christmas was on a Friday.
On what day of the week did Browne's birthday fall in that year ?

ANSWER. (i) Monday ; (ii) Tuesday ; (iii) Wednesday ; (iv) Thursday ; (v) Friday ; (vi) Saturday ; (vii) Sunday.

17. All the trains from this platform stop first at Ayton ; but after that some go to Beaton and Seaton ; and others branch off to Deeton and Eaton. There are no other stations. The fare to Eaton or Seaton is one shilling ; elsewhere sixpence.

Brown had a sixpenny ticket, and, although in a hurry, did not get in the first train, which was going towards Eaton.

Where do you think he was travelling to ?

ANSWER. (i) Ayton ; (ii) Beaton ; (iii) Seaton ; (iv) Deeton ; (v) Eaton ; (vi) Either Ayton or Beaton ; (vii) Either Beaton or Deeton ; (viii) It is impossible to say without further details.

18. The murdered man made the following statement just before his death :—
" I heard the clock strike yesterday, a quarter of an hour before the first shot was fired. I was too occupied to count the strokes of the clock-bell, but from the rhythm I am sure it must have been an even number. I had been out of doors for fifteen hours continuously since the preceding midnight, and had not long returned."

The man's clock had stopped at 5 to 6 that same evening.

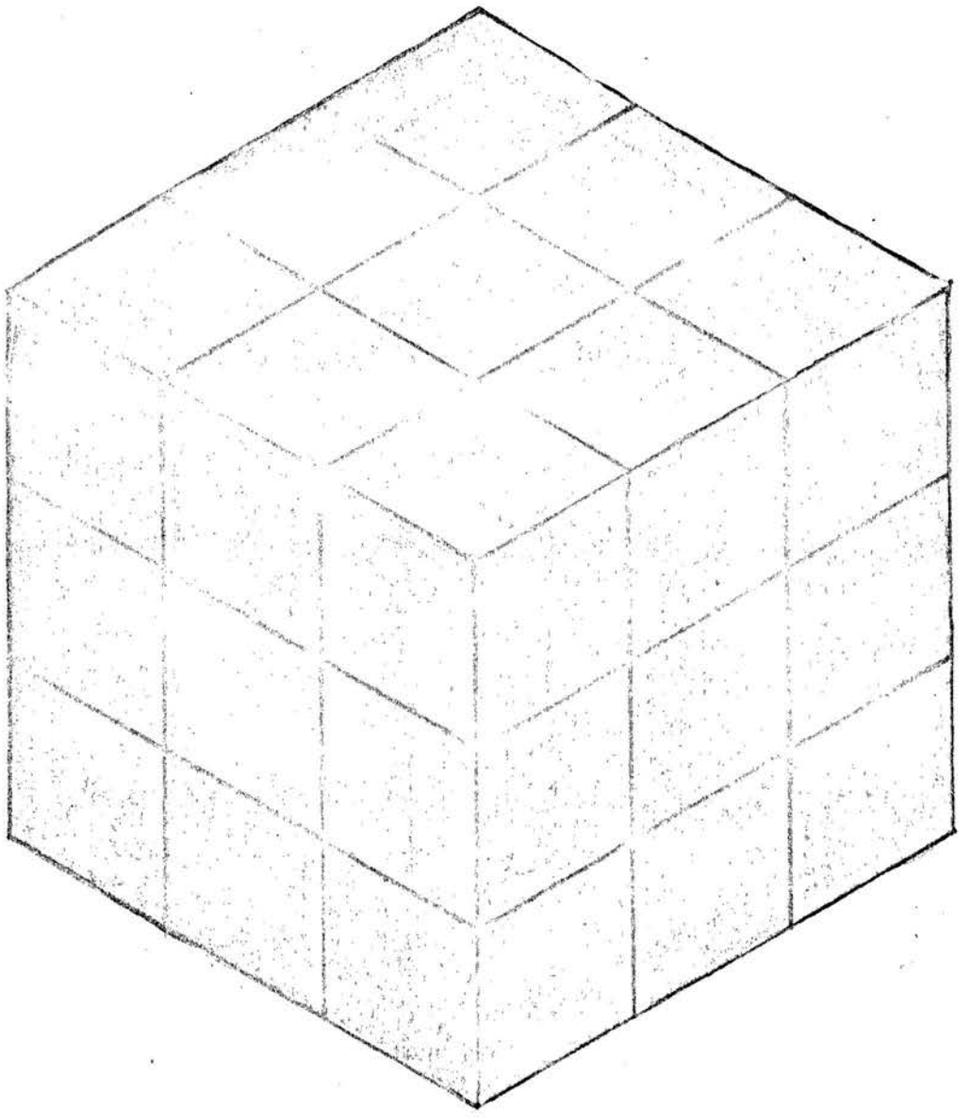
When do you think the first shot was fired ?

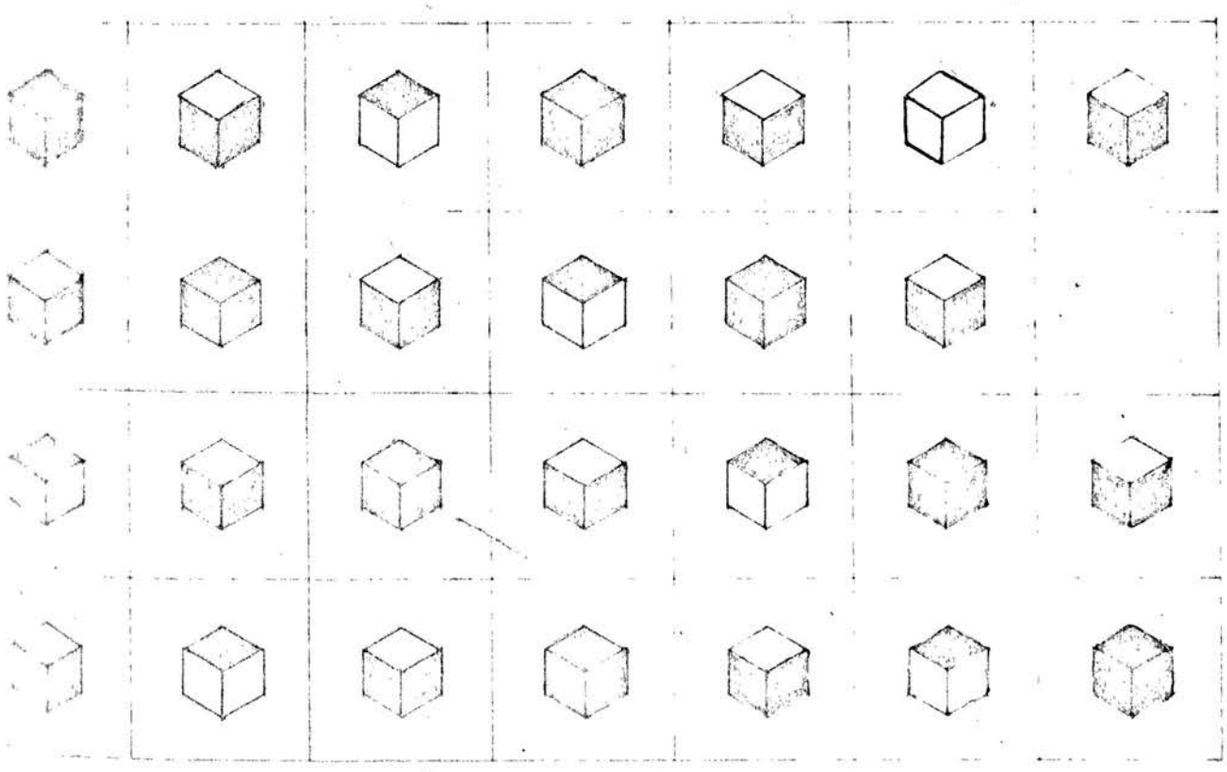
ANSWER. (i) About 4 o'clock ; (ii) $\frac{1}{4}$ to 4 ; (iii) 4.15 p.m. ; (iv) 5.15 p.m. ; (v) 6.15 p.m. ; (vi) $\frac{1}{4}$ past 4 in the morning ; (vii) Impossible to say without further details.

MAXIMUM = 18

CUBE BUILDING TEST

This test is similar to that used by Link and described in "Employment Psychology" page 124. It consists of a 3" cube cut into 27 one inch cubes. The outside faces of the larger cube were painted black and so some of the faces of the 1" cubes were black. The subject was given the 27 one inch cubes arranged in standard order as seen in Fig. I. It will be seen that all the black faces on the small cubes are presented to the subject so that it was unnecessary for him to pick up any cube to see how many of the faces on it were painted black. The subject was then told that he was required to build with the 27 one inch cubes a 3" cube which when completed should have all the faces black. The time taken to build the complete cube was measured by the author with a stop watch which was started when the subject commenced to work and stopped when the last of the one inch cubes had been put in its place. The factors taken into account were (a) the time taken (b) the number of false moves made by the subject and corrected by him in the course of the test (c) the number of false moves not noted by the subject (hence the number of small cubes in their wrong place in the final large cube) and (d) the method adopted in building the large cube. The number of false moves noted and corrected is included in the time taken since the correction of the false moves increases the time. The "method" adopted is strictly non-quantitative but shows itself probably in the correlation with Intelligence, and is an indication of the capacity of the subject to grasp what was required of him and carry out the instructions; it indicates also if he works with system and with logical reasoning; it gives an indication of his capacity to conceive the large cube completed and indicates his space perception for this particular case.

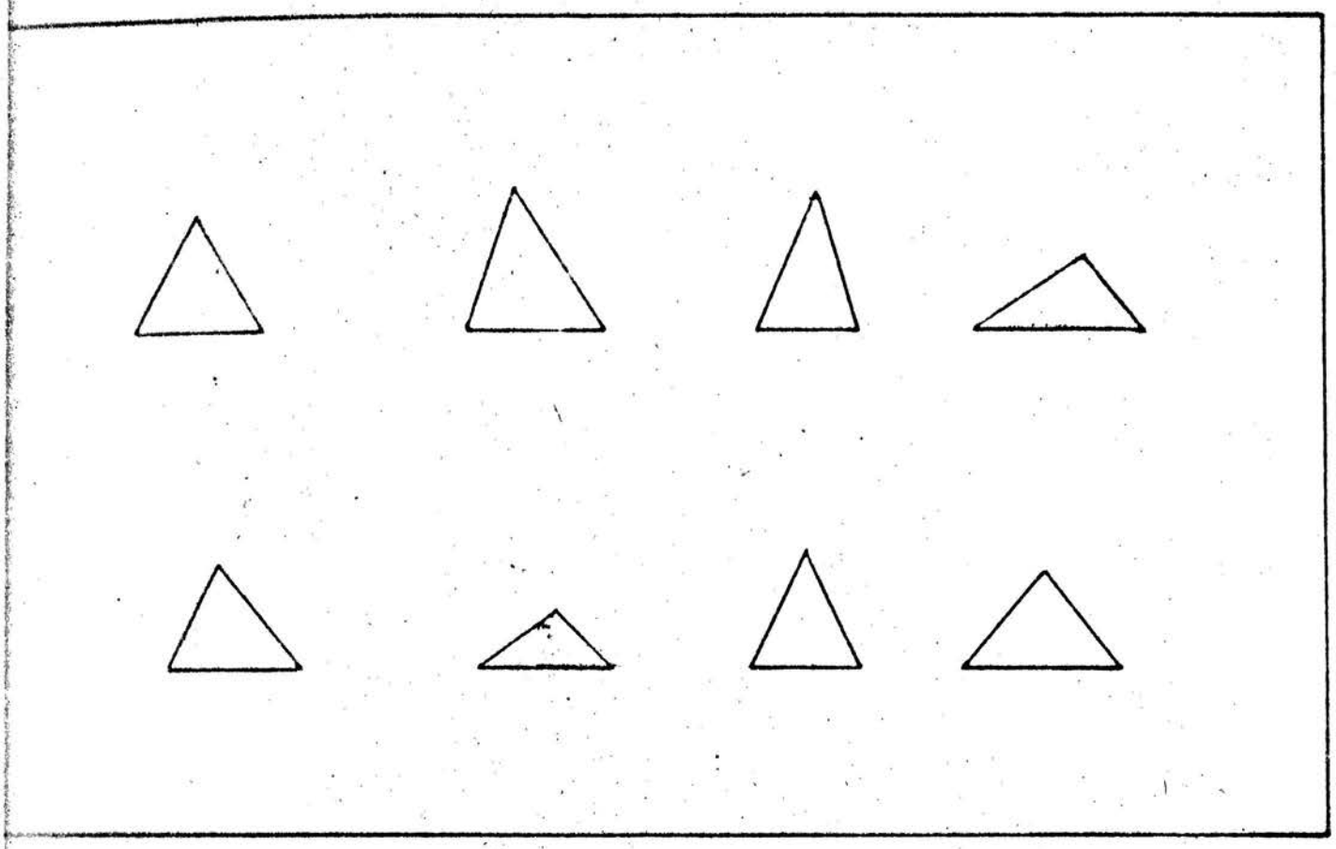


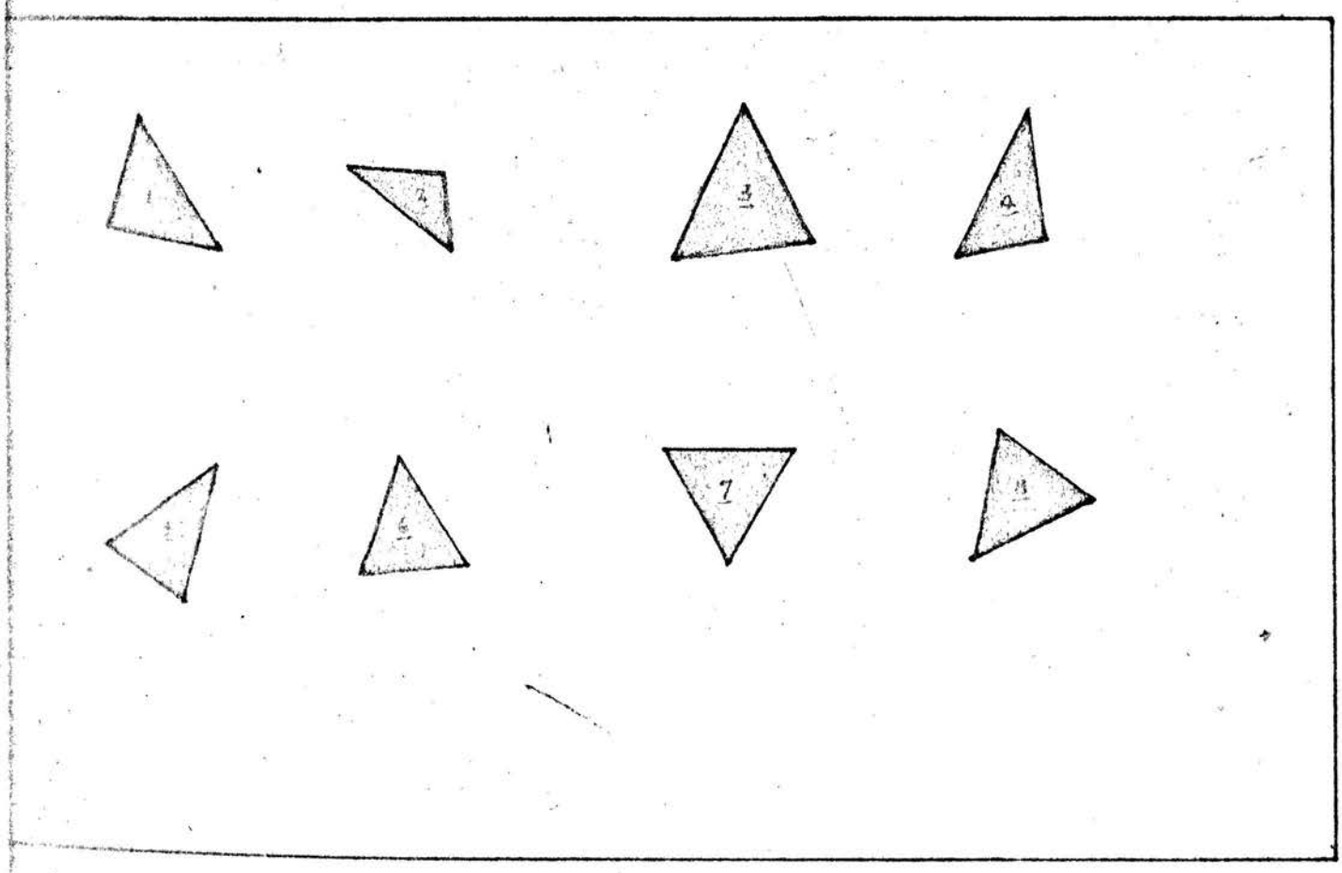


CUBE BUILDING TEST FIG 1.

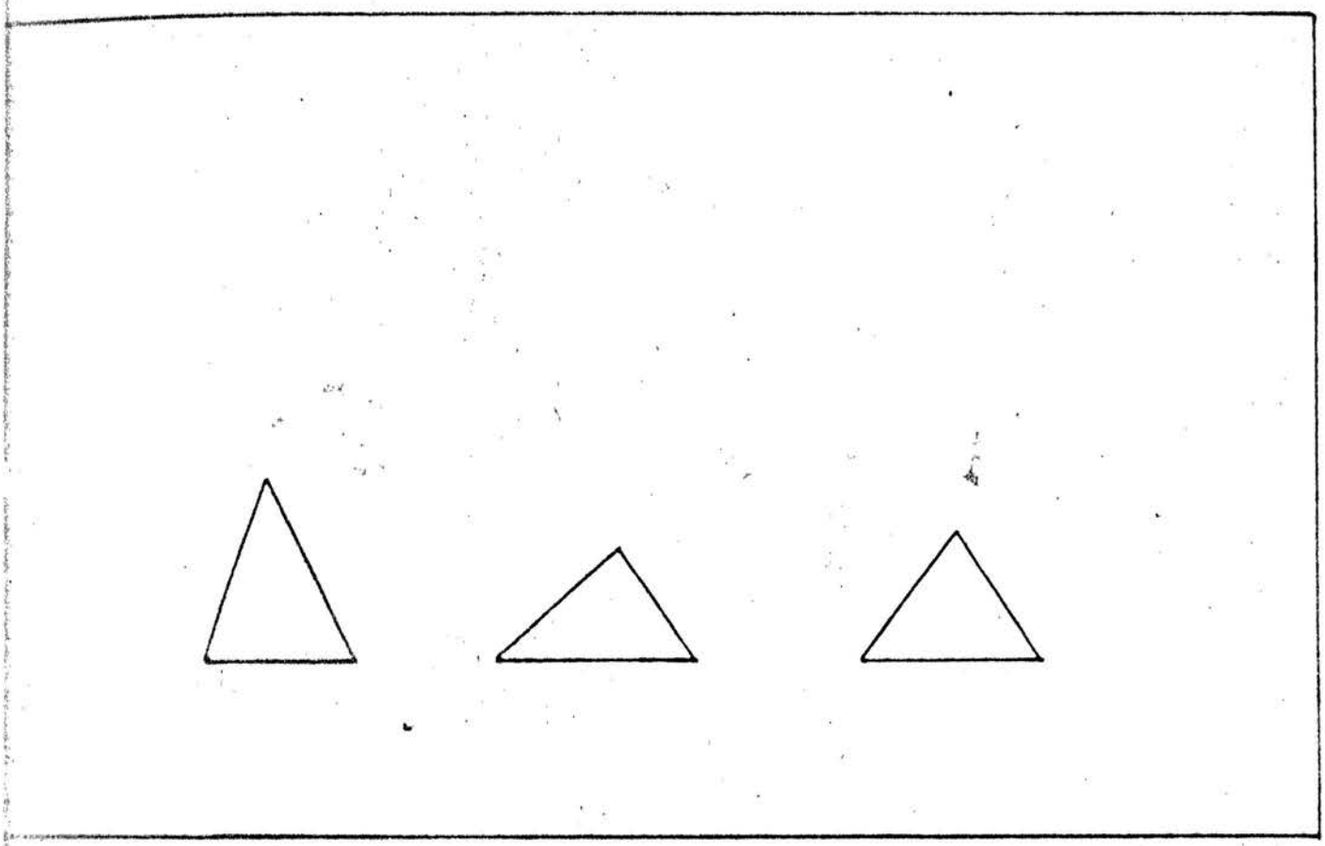
FORMBOARD TESTS.

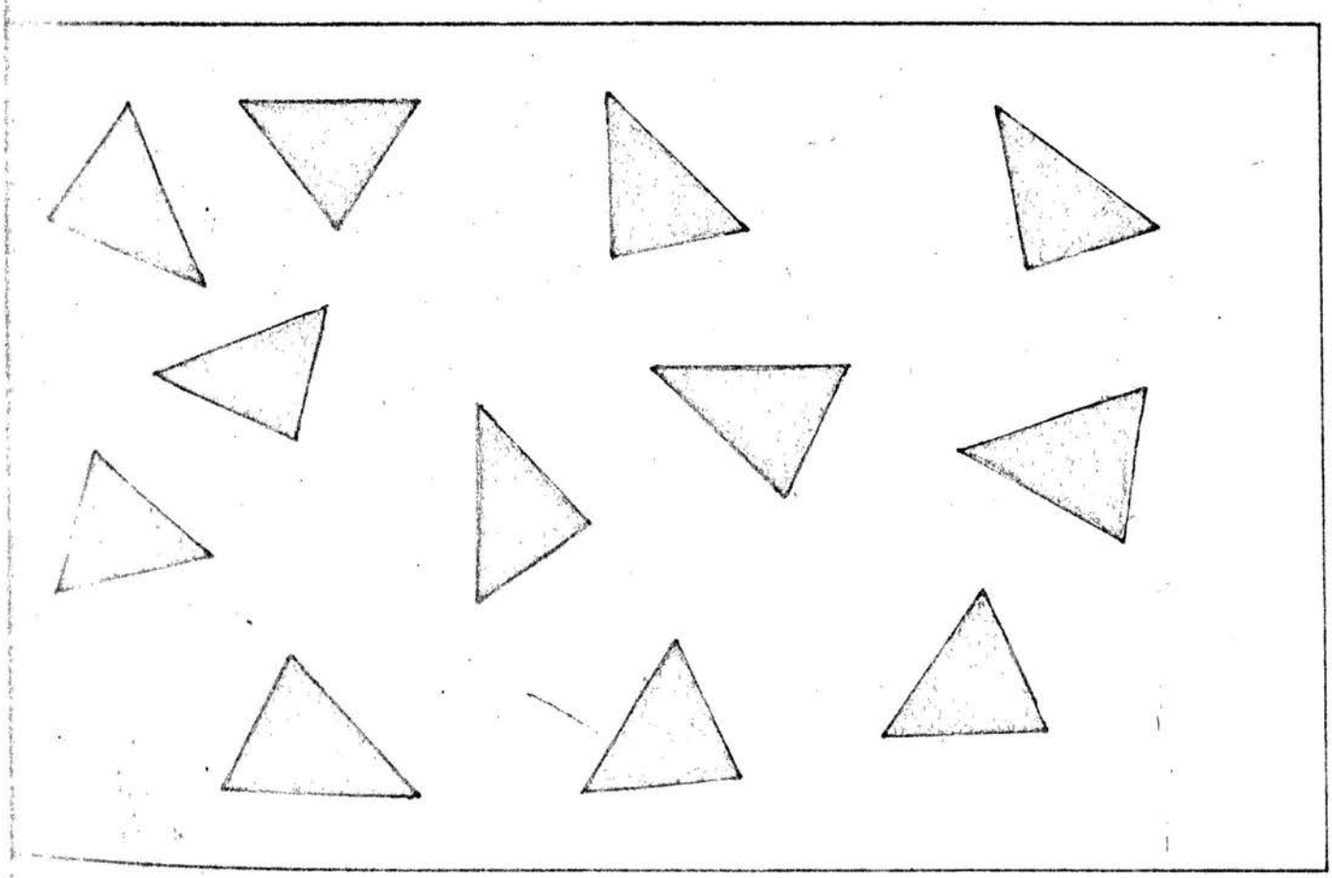
In these tests the subject was required to place small triangular pieces of metal of different shapes and sizes on a formboard on which are painted spaces, which exactly suit the triangular pieces of metal. The formboards (Figures 2 and 3) are of wood and measure 15" x 12". They are painted black and have the triangular spaces painted white on them. The formboard in Fig. (2) has eight triangular spaces painted on it and that in Fig. (3) has three triangular spaces painted on it. Three tests are performed with the former and one with the latter. With the formboard in Fig. (2) the first test was to place on it correctly the eight triangular pieces which for every subject were laid out in a standard position as shown in Fig. (2). The numbers on the metal pieces have no relation to position on the formboard but were for the convenience of the author in the lay out of the standard formation and were also an aid in checking the correctness or otherwise of the pieces after they have been placed by the subject on the formboard. The second test was similar to the first except that the eight pieces were laid out haphazard and the subject was required to fill the eight spaces exactly as before. In the third test the metal triangles were duplicated. That is to say instead of only eight pieces from which to choose there were sixteen pieces. The subject had now to choose from sixteen pieces, among which there were two pieces which fitted each space, eight pieces to fit the spaces on the formboard. The layout of the pieces in this test was also haphazard. In the fourth formboard test with formboard in Fig. (3), there were three spaces to be filled and for this the subject had to choose three pieces from twelve metal triangular pieces of which four each fitted each of the spaces on the formboard. The lay out of the pieces here was haphazard





FORMBOARD TEST FIG. 2.





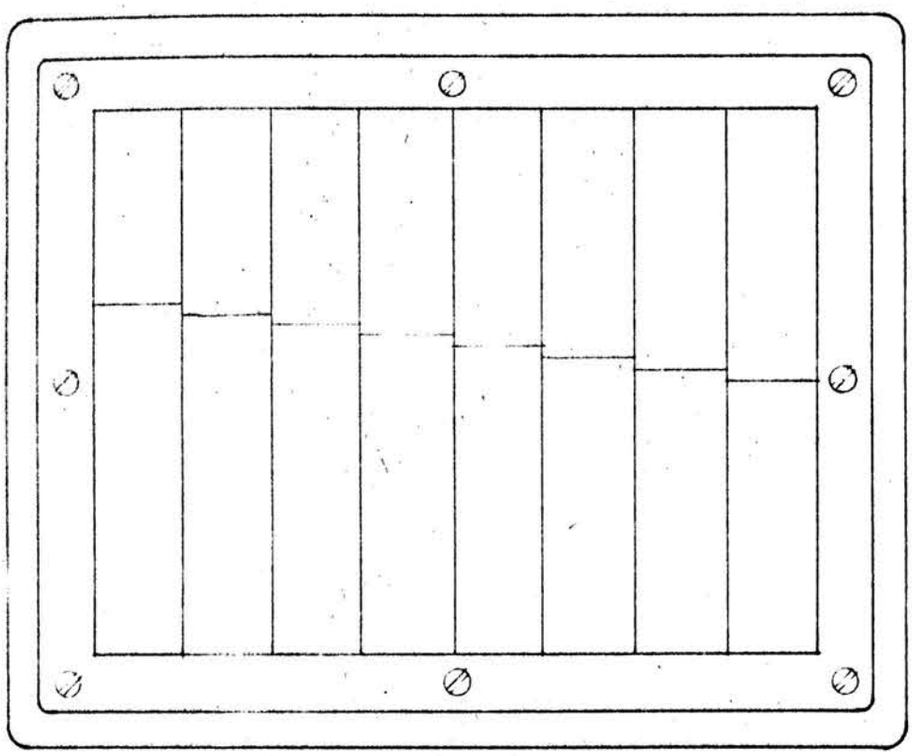
FORMBOARD TEST FIG. 3.

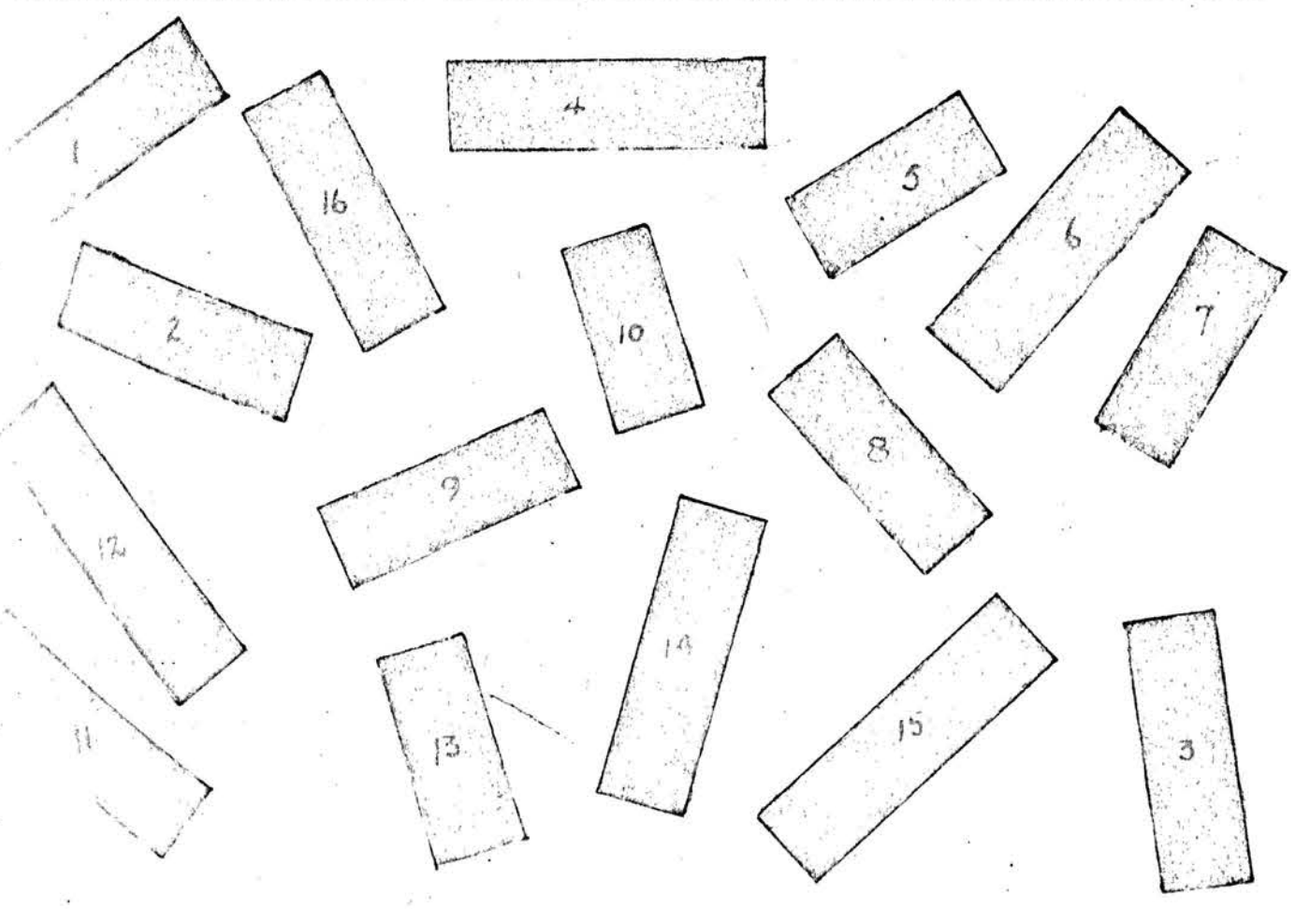
and is shown in Fig. (3).

The factors taken into account in these formboard tests are very similar to those in the cube-building test. The time taken was observed, and the number of false moves noted and corrected by the subject, (which false moves increase the time taken to complete the test), and the number of pieces placed wrong and left uncorrected at the finish of the test were recorded. Here again the method adopted is important for the test may be completed by space judgment or by trial and error. As spatial perception was particularly desired the subjects were asked to endeavour to complete the tests by judging the size and shape of the pieces to fit the spaces and to perform the test in this way, but in spite of this some of them performed the test by a trial and error method. However it probably did not matter very much since the measure of the test was dependent on the time taken and this was greater by the trial and error method than by the exercise of space judgment on account of the greater number of moves required to complete the tests.

STRIP-BUILDING TEST.

This test consisted of fitting into a shallow tray 8" x 6", sixteen brass strips each one inch wide two of which just make up the width of the tray. The strips vary in length by one-eighth inch and the sizes of the pieces vary from $2\frac{1}{16}$" to $3\frac{15}{16}$". The sixteen strips were placed on the standard positions board as shown in Fig. (4) and it was explained to the subject that two pieces taken together would just make up the width of the tray while all the pieces would just fill the tray. He was required to fill the tray as quickly as possible. The time taken and the method of performing the test were noted. Actual manipulation plays an important part in this test and whatever method was employed did not seem to affect greatly the time





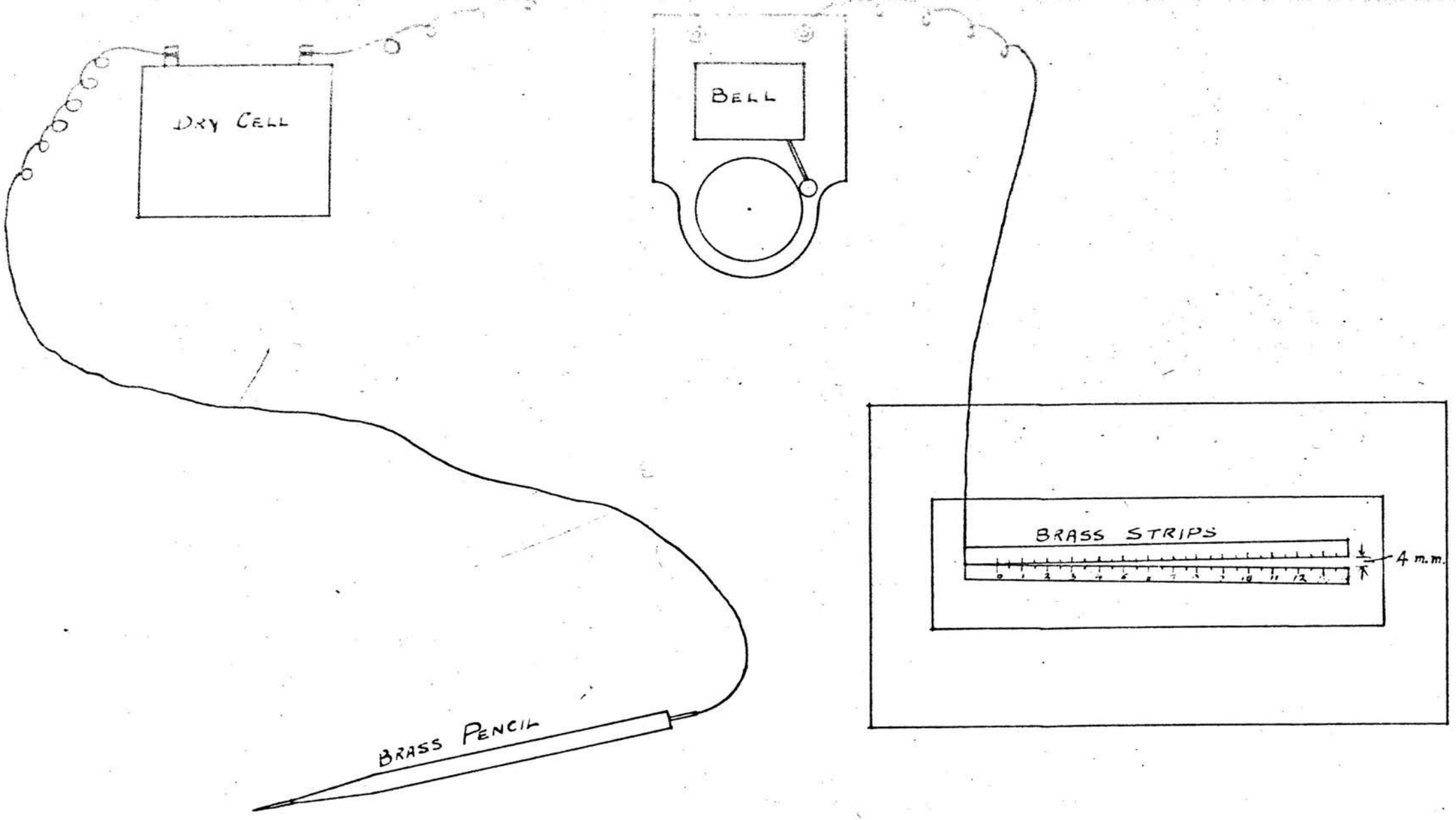
STRIP BUILDING TEST FIG. 4.

taken in the performance of the test. The method employed however is probably an indication of 'mechanical intelligence' or of the systematic (or non-systematic) worker.

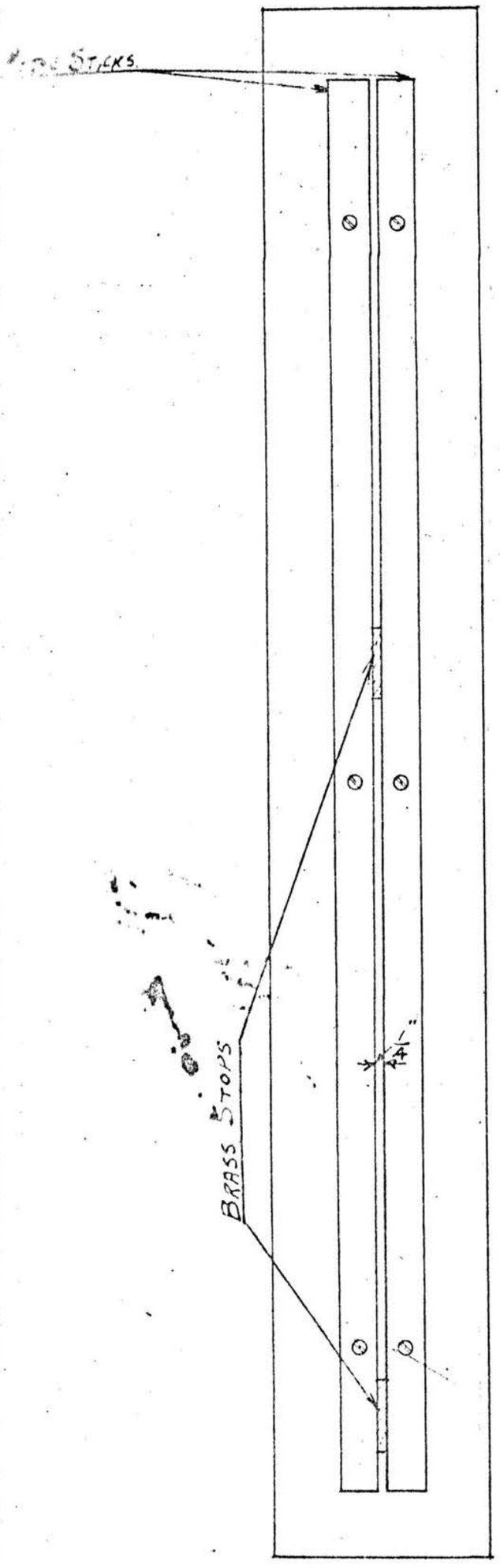
ACCURACY OF MOVEMENT TESTS.

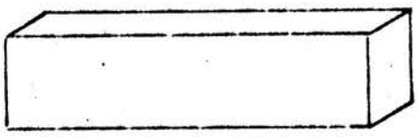
The tests used for determining accuracy of movement are shown in Figures 5 and 6. One was performed with the subject's eyes open, the other with his eyes blindfolded. The test(Fig. 5) consists of moving the brass pencil between the two brass strips till contact takes place between the pencil and the strip. Immediately contact takes place the electric circuit is completed and the bell rings. The strips are of brass $\frac{1}{8}$" x $\frac{1}{8}$" fixed on an ebonite panel. They are set in contact at one end and the opening at the other end is 0·4 cm. The strips are marked off in cms. and mms. and the total possible movement of the pencil is 15 cms. The subject was required to perform the test six times in all, three times with the right hand and three times with the left hand. The position at which contact takes place was noted in all six cases and the total possible distance less the distance moved was taken as a measure of accuracy of movement.

In Fig. 6 two meter sticks are fixed on a long strip of wood at a distance of $\frac{1}{4}$" from each other. Two brass stops each 2" x $\frac{1}{8}$" x $\frac{1}{4}$" thick and a steel pencil with a spherical end $\frac{1}{4}$" diameter complete the apparatus for this test. The subject was blind folded and the brass stops were fixed between the meter sticks. The positions of the stops were then noted by the author. The subject then placed the spherical ball of the steel pencil against one of the stops and was required to move the pencil along between the meter sticks till it was stopped by the second stop. He then returned the pencil till it was in contact with the first stop; in the meantime the author removed the second stop and asked the subject to move back the pencil to the

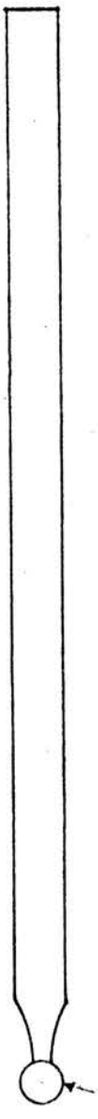


TEST FOR ACCURACY OF MOVEMENT FIG 5.





Brass Stops 2" x 1/2" x 1/4" thick



Steel Pencil.

Test for Accuracy of Movement. Fig 6.

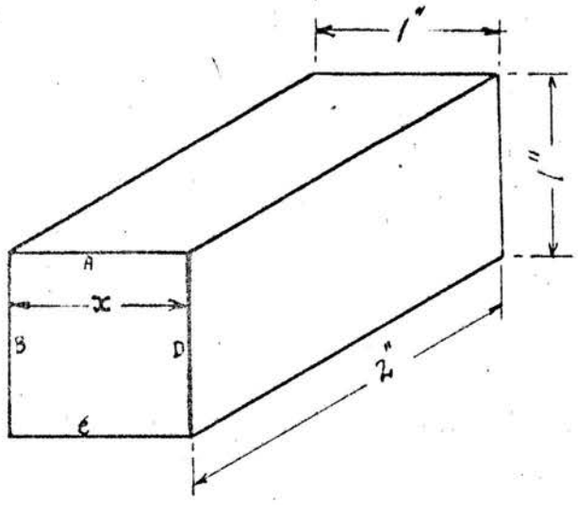
same spot as it was when against the second stop. Two trials were given before the estimates were noted and this test was done by the subject three times with each hand. The subject was at liberty to move either from left to right or from right to left but most chose to move from right to left. No indication of the accuracy, or otherwise, of the movement was given to the subject nor had he any indication of the distance through which the movement was to take place. In most cases the estimate of the movement seemed to be based on local signature of the muscles but in a few cases other factors such as the time taken to carry out the movement and judgment of distance as evidenced by the jerky movement of the subject's arm, could be detected. In such cases the subject was asked to repeat the test and to estimate movement rather than time or distance.

TESTS OF ENGINEERING ABILITY.

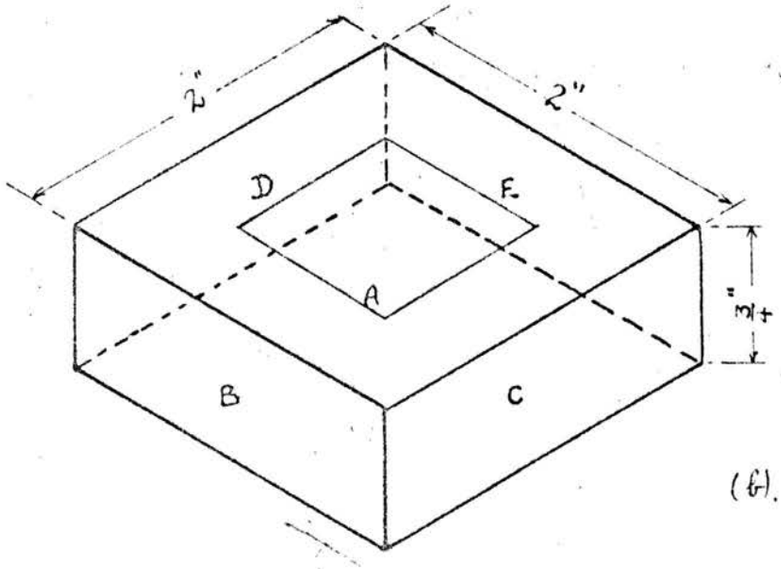
These tests are divided into three categories (1) Performance of work in turning and fitting in the Workshop Course. (2) Performance of work in the Patternmaking Course and (3) The work done in Engineering Drawing in the Drawing Office.

WORKSHOP FITTING.

The work performed is progressive beginning with elementary exercises and proceeding to more difficult jobs as each is completed. The subjects began with a simple job which introduced the use of hammer, chisel, square and files. A block of cast iron was provided (Fig. 7a) and it was required to have all four sides A.B.C and D finished to true surfaces so situated that the finished cross-section was a perfect square of one inch side. This entailed chipping with hammer and chisel and filing smooth after chipping, sides A, B and C, the side B being made at right angles to A



(a).



(b).

CAST IRON BLOCKS FIG 7.

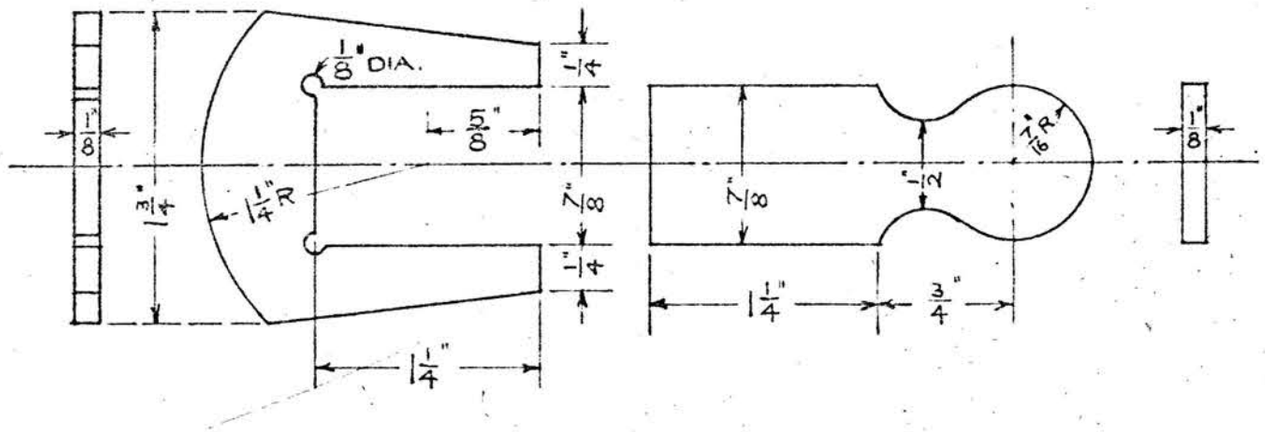
and the side C was then made parallel to A; the side D was then finished in the shaping machine. Another cast iron block was then provided (Fig. 7(b)). The face A and the four edges B, C, D and E, had all to be machined in the shaping machine so that the edges formed a rectangle each rectangle being at right angles to the face A. It was then required to make a square hole through the block to fit the 1" square block (a) made already. This was done by drawing diagonals on face A and so finding the centre. A circle was then drawn $\frac{1}{8}$" less in diameter than the width x of the block (a). A hole of this diameter ($\frac{7}{8}$") was then bored in the drilling machine, and it was then filed out to 1" square. It is now easy to judge the accuracy of the work by fitting block (a) into block (b). The block (a) should fit into block (b) in whatever way it is turned about.

GAUGES.

A new material was then introduced. With a piece of $\frac{1}{8}$" thick steel plate, outside and inside gauges had to be made, (Fig. 8) With the hacksaw the piece $1\frac{1}{4}$" x $\frac{7}{8}$" for the outside gauge was cut and the edges were finished with the flat file. In making these gauges, square, half-round, and round files were used and as the fit had to be very accurate whichever way the inside gauge was fitted into the outside one great care was required in finishing the edges. As it is very easy to make the inside gauge too small or the outside one too large, close examination of the finished job is necessary to see that the subject has not resorted to punching the plates to secure the necessary fit.

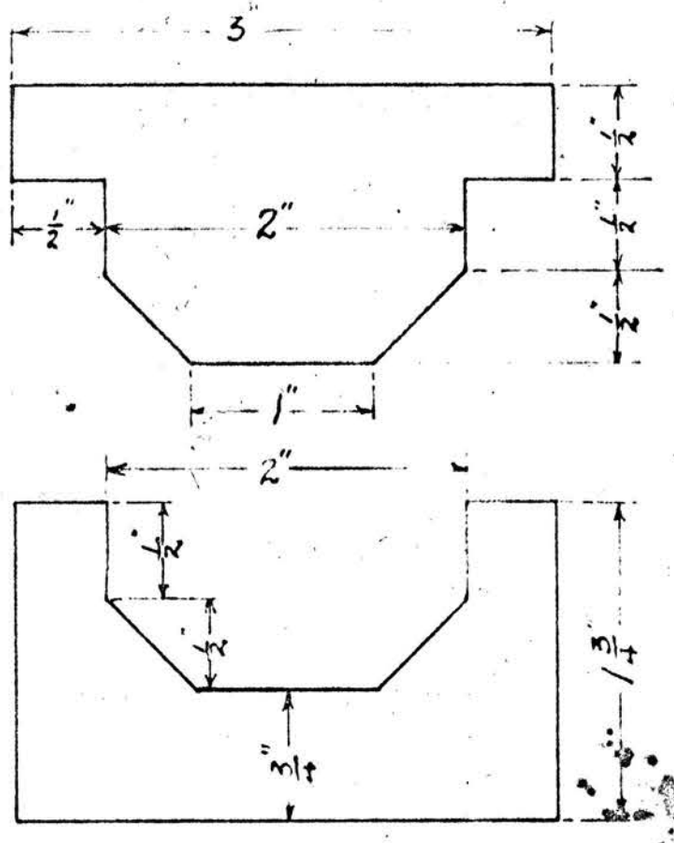
Two more gauges with a larger number of faces to be fitted constituted the next fitting job. These are seen in Fig. 9. Seven faces in each gauge had to be fitted and the gauges had to fit if one was reversed. Symmetry about a centre line must therefore be obtained and the job had to

INSIDE AND OUTSIDE GAUGES.

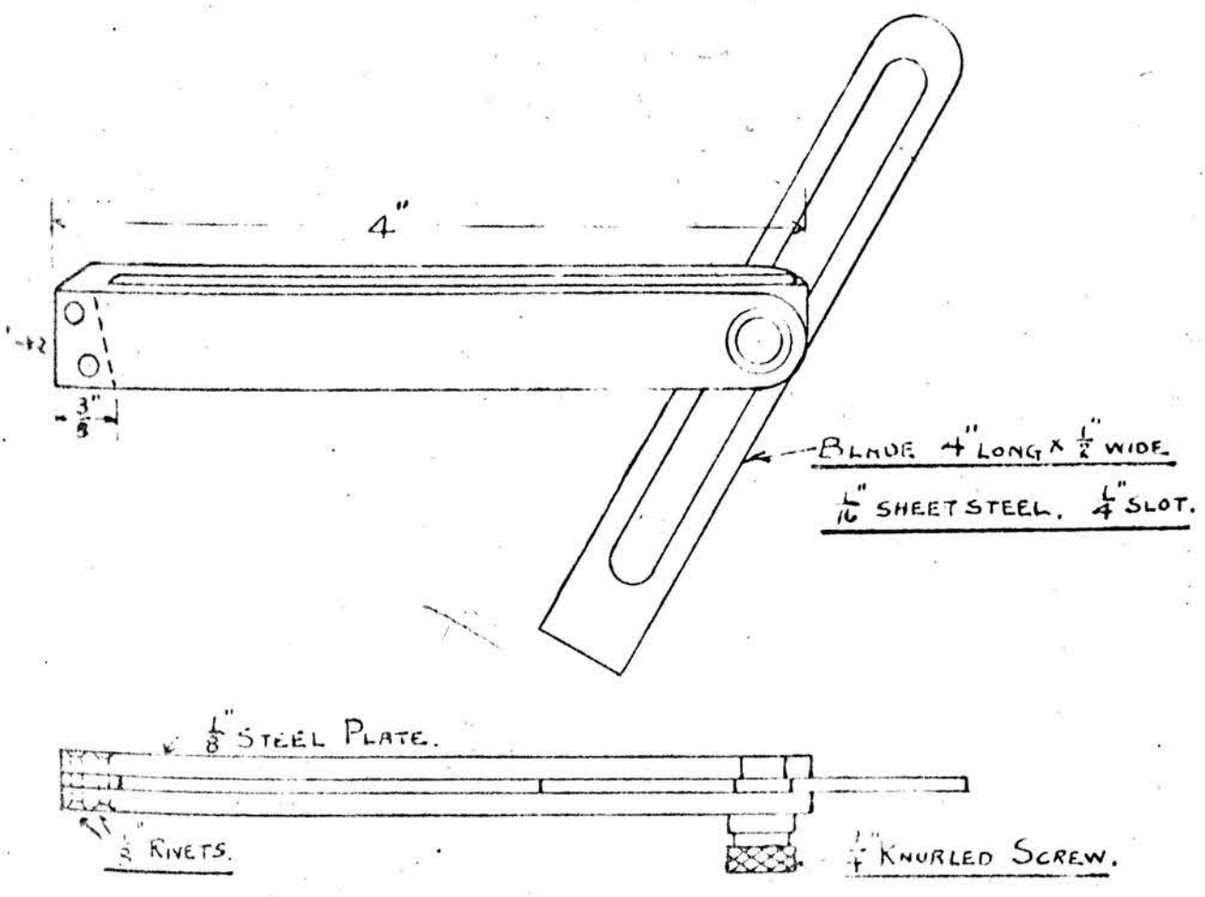


FITTING EXERCISE

FIG. 8.



INSIDE AND OUTSIDE GAUGES FIG 9.



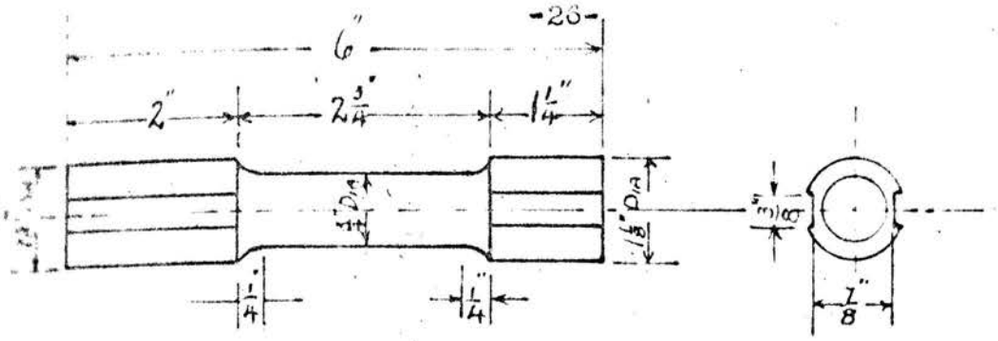
BEVEL GAUGE FIG 10.

be marked off from such a centre line.

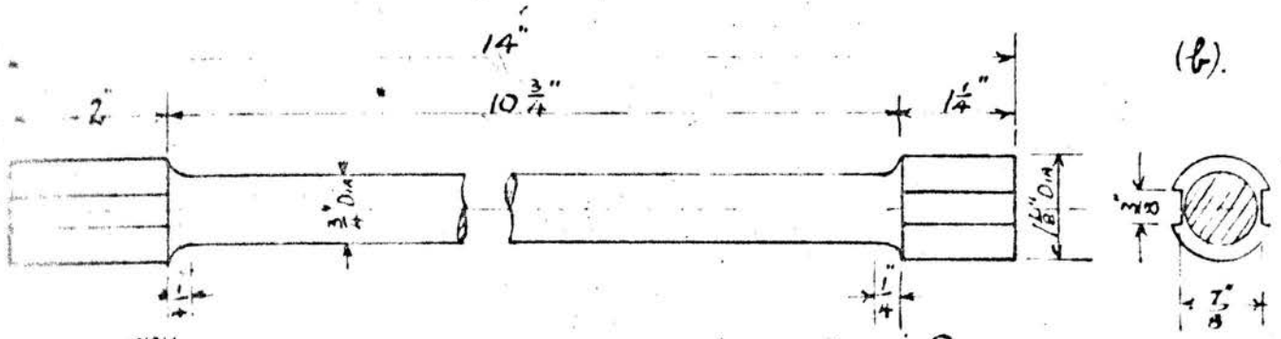
The last of the fitting exercises consisted in making a Bevel gauge as shown in Fig. 10. This is an application of the previous jobs. The blade was made of $\frac{1}{16}$" thick sheet steel and the handle of two pieces of $\frac{1}{8}$" steel plate with a piece of $\frac{1}{16}$" plate riveted between them. A $\frac{1}{4}$" knurled screw had to be made for fixing the adjustable blade which has a $\frac{1}{4}$" slot in it. The whole had to be finished and polished so that the rivet heads were indistinguishable in the handle. The edges of the blade and handle required to be made true.

TURNING.

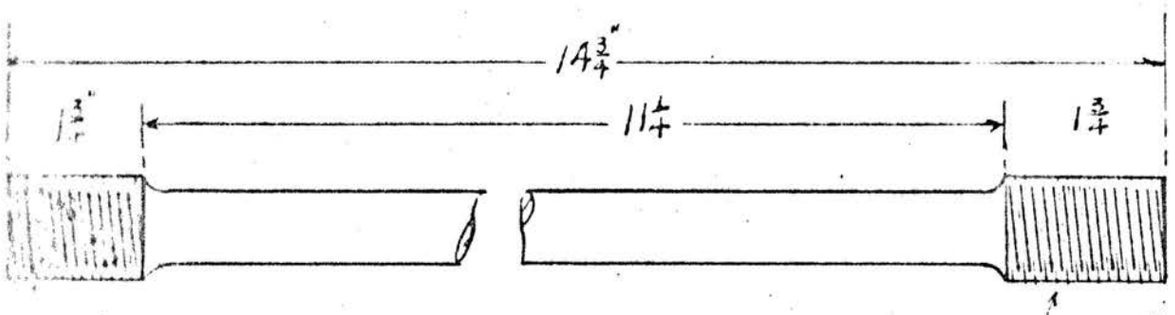
The first turning job to be performed by the subject was the making of a 2" Cast Iron Torsion Specimen. He is provided with a blank specimen of Cast Iron about $6\frac{1}{4}$" long and about $1\frac{3}{8}$" to $1\frac{1}{2}$" diameter and is required to make a specimen as shown in Fig. 11(a). The given blank specimen had to be trued up to see if the required specimen could be obtained from it. This done the whole was turned in the lathe to a diameter of $1\frac{1}{8}$". The centre piece was then turned down to $\frac{3}{4}$" diameter for a length of 2" and the filets $\frac{3}{8}$" radius were allowed for. The ends were then squared and the slots marked off and cut in the milling machine. All the turning had to be done in the lathe—no files were allowed—and the subject had to learn what cuts can be made when working with Cast Iron, what tools to use, and how to watch them. The next specimen Fig. 11(b) had then to be made—a 10 inch Mild Steel Torsion Specimen. The procedure was much the same as in the previous job but the different material required different treatment. Owing to the generation of heat between the tool and the specimen, a lubricant is required. Also the cut is different from that in the Cast Iron specimen. For these torsion specimens the ends



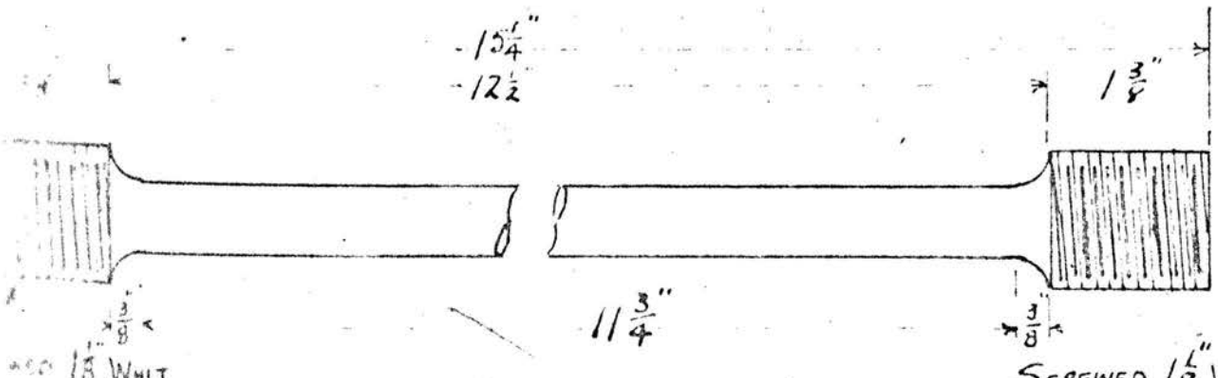
2 INCH TORSION SPECIMEN C. IRON



10 INCH TORSION SPECIMEN MILD STEEL

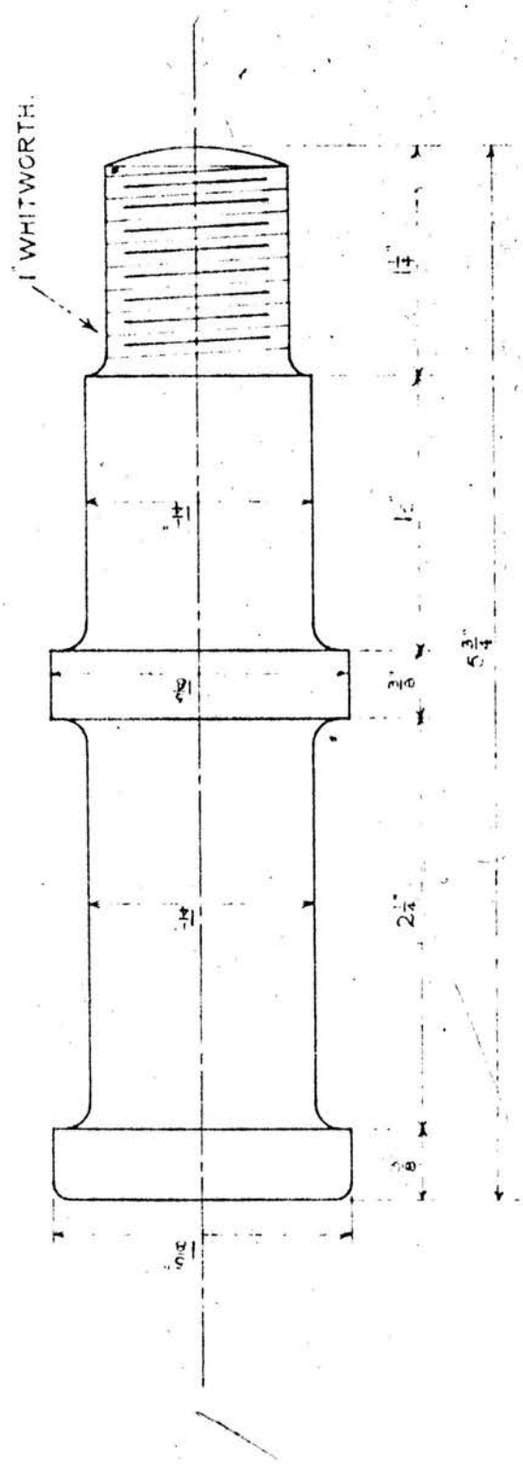


10 INCH TORSION SPECIMEN M.S.



10 INCH TORSION SPECIMEN C.I.

TURNED SPECIMENS FIG. 11.



TURNING EXERCISE

FIG. 12.

were required to be made to fit a gauge of the dimensions as shown in the end views of the specimens (a) and (b).

Two more specimens had to be turned as shown in Fig. 11 (c) and 11(d). One is of cast iron and the other of Mild Steel. Instead of the ends being made to fit a gauge, these specimens being for Tension have screws cut on the ends. The subject was thus introduced to screw-cutting in the lathe and as each specimen had different screws on the ends the changing of the lathe wheels for the different number of threads per inch of screw was introduced.

A further turning job had to be done embodying most of the previous turning exercises together with screw-cutting. (See Fig. 12) A time factor was introduced at this job, three hours being allowed to complete it. This makes it possible to examine speed of working along with accuracy of working. Further work was done in dressing and tempering tools but no evaluation was made of this work as was made in the Fitting and Turning work and it is consequently omitted here.

PATTERNMAKING.

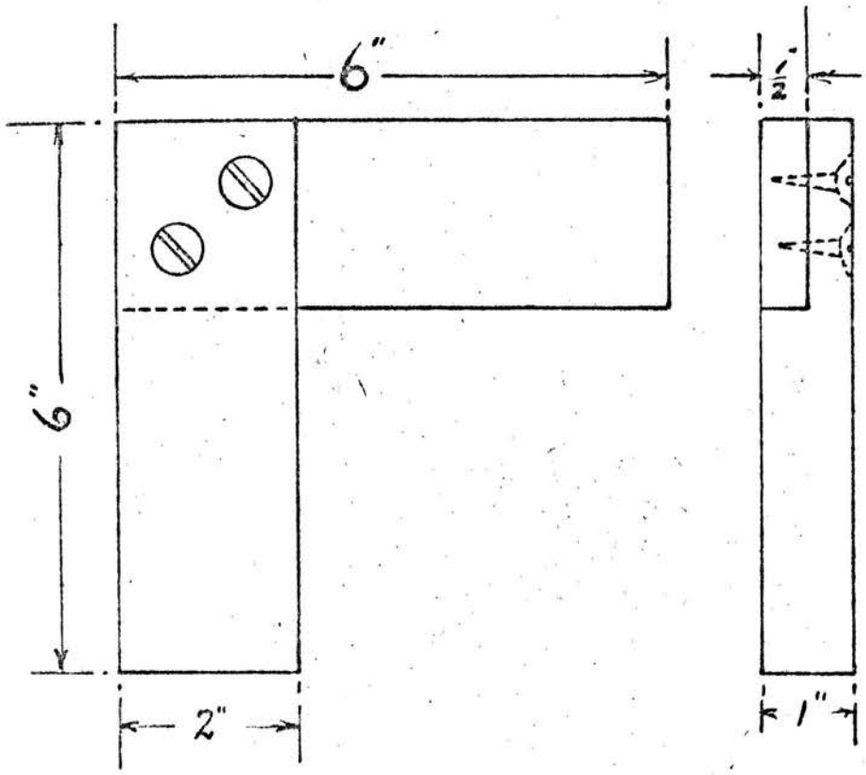
The subjects take this course after the Workshop. Like the fitting and turning jobs those in the pattern-making are progressive beginning with elementary and proceeding to more difficult tasks which involve those already learnt. Generally speaking patterns are made in wood although other materials such as Plaster of Paris and Iron are used in particular cases where these are more suitable. The work done by the subjects in the investigation was done in wood, the use of the other materials being pointed out as the occasion arose. The woods generally used in pattern-making are American Yellow Pine and Redwood but hardwoods such as Mahogany and Plane Tree are sometimes used. The work done by the subjects was of Yellow Pine wood, which

is easily worked, is light, glues well, is durable if kept dry, and does not tend to warp or shrink like other soft woods.

The first job was to dress a piece of timber. This introduced the jack plane and trying plane and the subjects learned control of these. When this had been achieved exercises were done which gave practise in paring with chisels. The first of these was a Corner Halfing Joint (Fig. 13(a).' Two pieces of timber were dressed to size 6" x 2" x 1" and the joint marked off as in Figure. A tenon saw was used to cut out the joint roughly and the joint was then pared off with the chisels so that the two halves fitted exactly. The joint was then assembled by screwing together as shown and all the ends were pared off to finish the job. As this joint is of most common occurrence in patternmaking its mastery is of the utmost importance

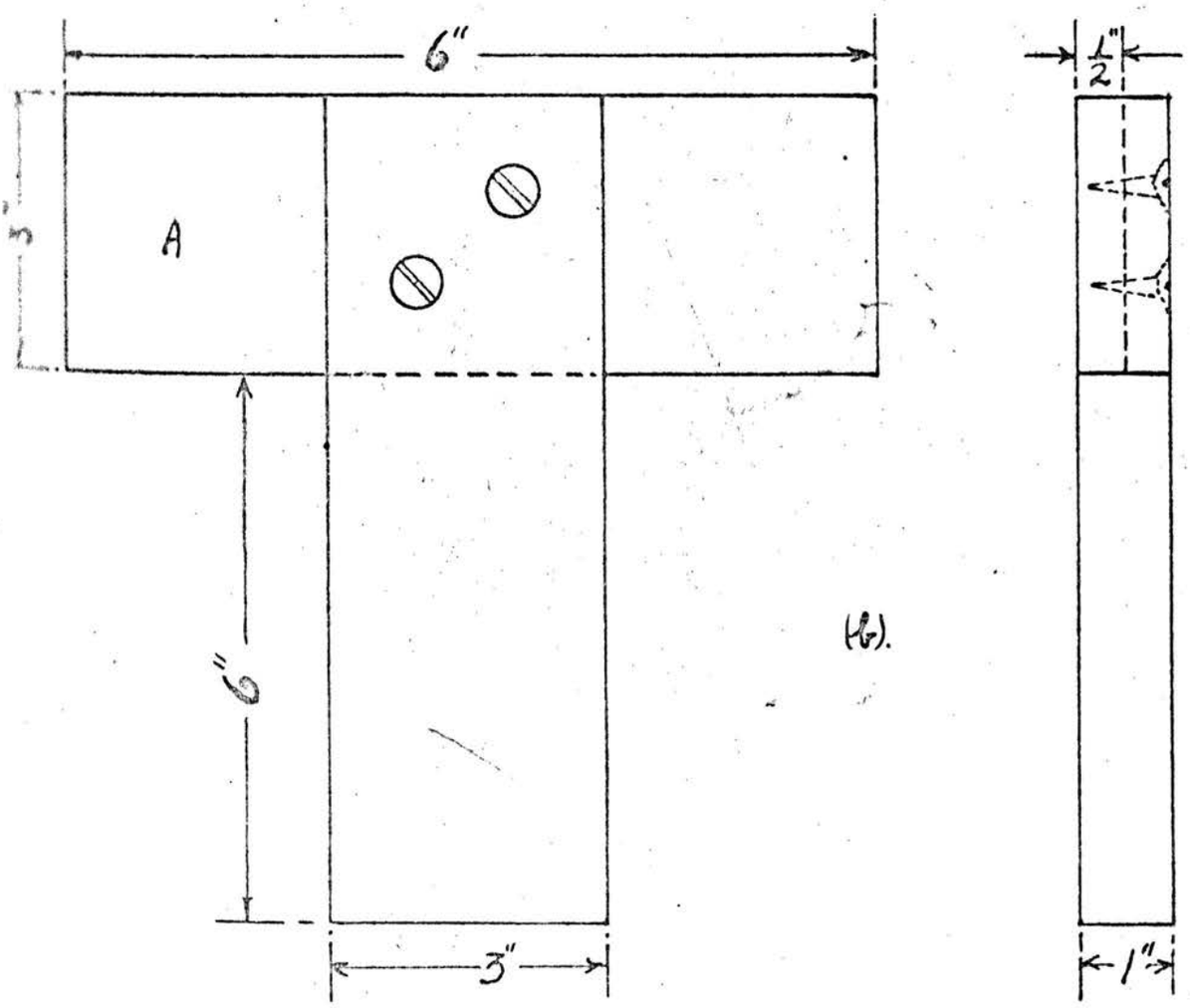
The next job was to make a T Halfing Joint Fig. 13(b). This joint is similar to the previous one except that it is made at the middle of one of the pieces of timber. The tools used and procedure are the same except that in cutting out the half thickness of the head piece A, care has to be taken not to split the timber. The joint was marked off on the head piece, then a number of saw-drafts were made and a narrow chisel used to remove the small portions between the saw-drafts, one at a time. The joint was then pared, assembled, and the ends pared off as in the previous job.

A pattern for a flat rectangular plate had now to be made. (See Fig. 14.) This involved the making of four corner halfing joints with the corners rounded off. Extreme accuracy was required here as each corner must be dead square and the halfing must be parallel or else a twisted frame results. This job introduced a new factor, namely, the allowance which had to be made for contraction of the metal



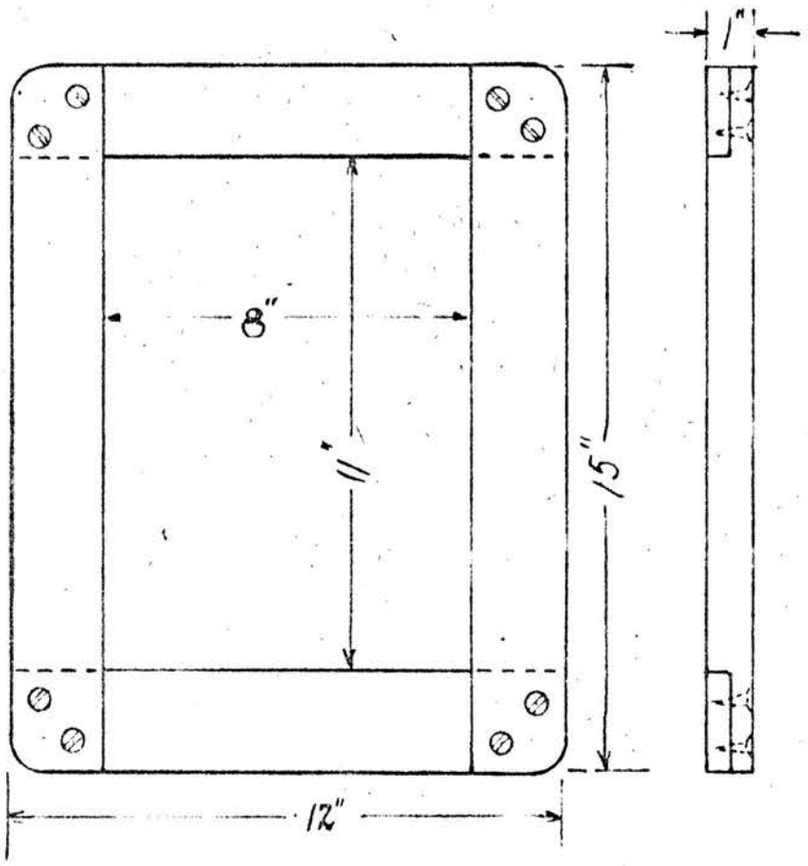
(a)

CORNER HALFING JOINT.

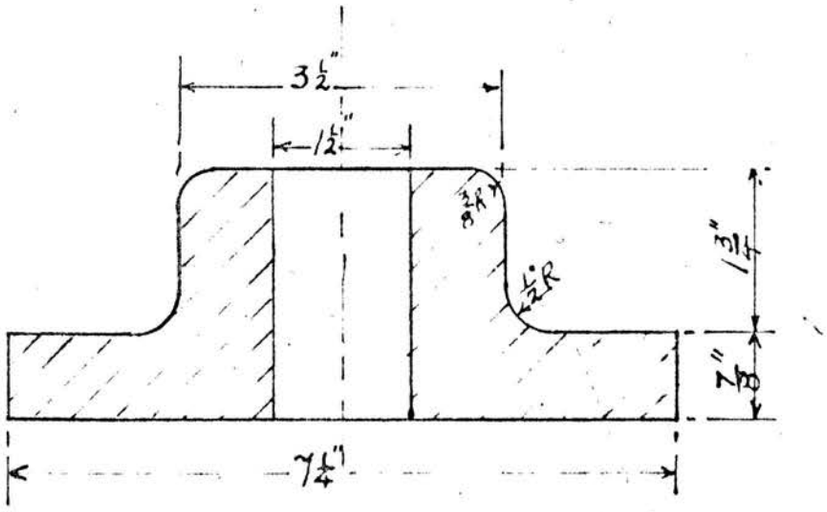


(b).

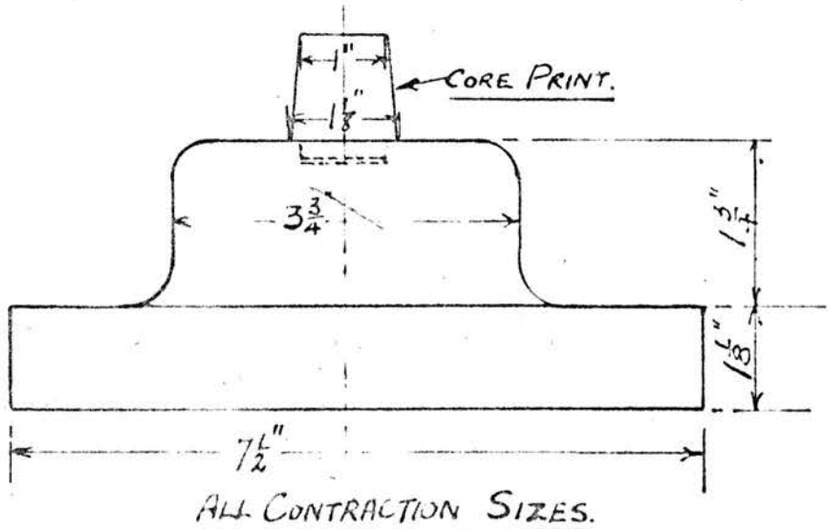
T HALFING JOINT. FIG 13.



PATTERN FOR FLAT RECTANGULAR PLATE 15" x 12" x 1" THICK. FIG. 14.



C.I. HALF COUPLING MACHINED ALL OVER



ALL CONTRACTION SIZES.

FIG 15.

when a casting is made. This contraction was allowed for by using a "Contraction" Rule for measuring out the sizes on the timber. (This 'Contraction' rule is a rule graduated to allow for the contraction of the metal; $\frac{1}{10}$" per foot for Cast Iron, $\frac{3}{16}$" per foot for brass, and $\frac{1}{5}$" per foot for steel. The contraction rule has thus three scales on it, one each for C. I., Brass and Steel respectively.) To complete the job a sweeper is required to remove the sand from the centre of the frame since a flat plate is to be cast. The subject was required to make this sweeper. (Note. A frame pattern is used instead of a solid pattern, to avoid the effect of shrinkage and warping of the timber over which the pattern maker has no control. The use of frame patterns where large castings are required results in considerable saving of timber.)

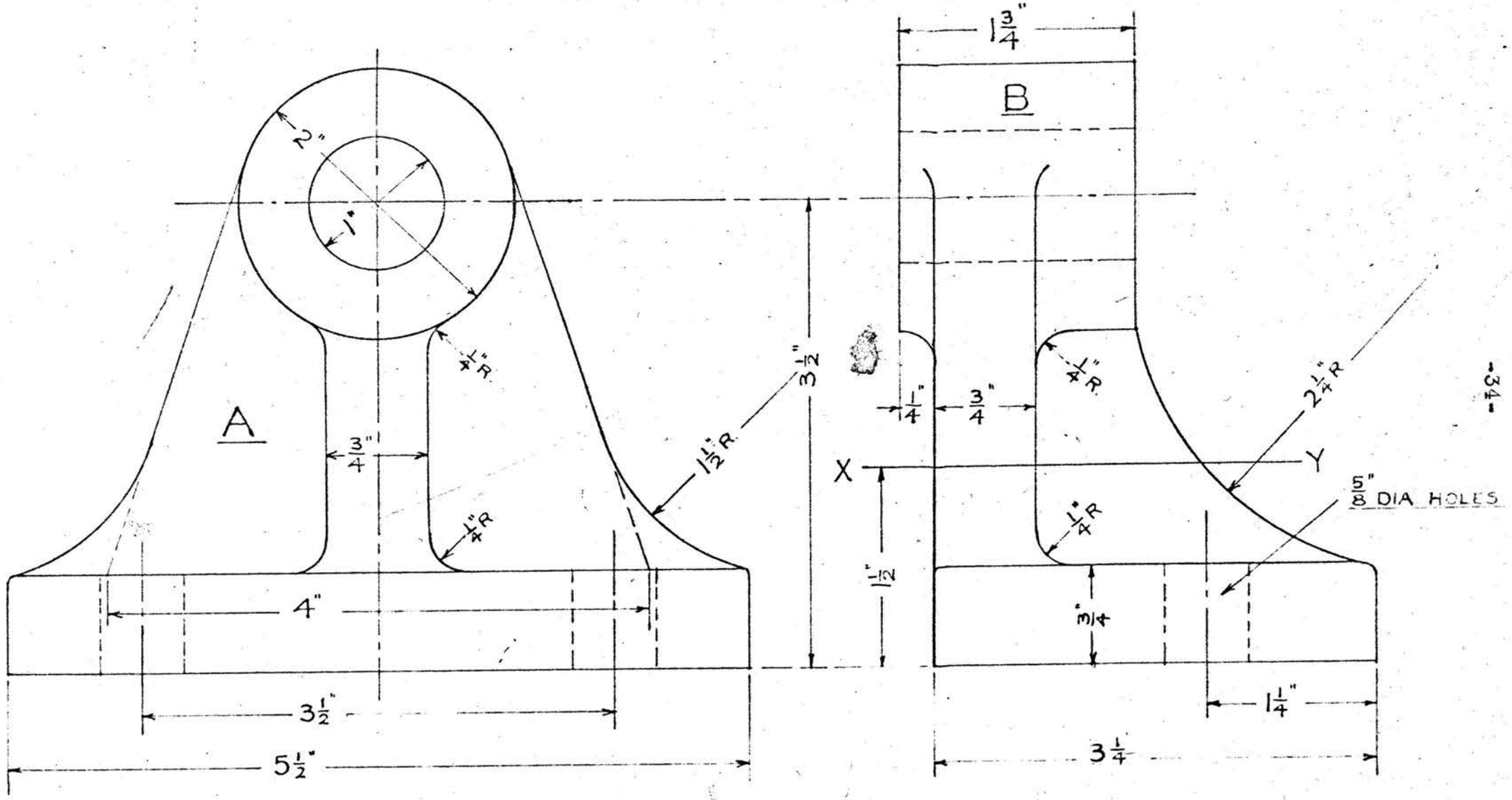
The next job was to make a pattern for a Half Coupling. This is shown in Fig. 15. Two new factors were introduced here. Since the coupling had to be machined all over an allowance of $\frac{1}{8}$" for machining had to be made. The hole in the centre is cored and an allowance of $\frac{3}{16}$" is made for machining cored parts. A section of the coupling was drawn out full size using the contraction rule and making the necessary allowances for machining. The finished pattern (and therefore the casting) will be like the lower sketch in Fig. 15. (The core print shown leaves in the sand a small recess into which a small column of sand, specially prepared, called the 'core' is inserted. This core now stands in the space left when the pattern is withdrawn from the sand and the metal flows round this core when the casting is made leaving the cored hole in the casting which is machined to the size required.) After the drawing of the pattern had been made a square piece of timber was dressed to the thickness of the flange and another piece to the

thickness of the boss. These were then cut circular allowance being made for turning. The flange and boss were then turned and screwed together and the core print was turned to the required size and fixed in place in the coupling.

The pattern for a cast iron Bearing Bracket was the next job. This is shown in Fig. 16. As in the half coupling pattern, the bracket required to be drawn out full size using the contraction rule for the size and making the allowances for machining. In this job webs and ribs require to be shaped and in order to avoid having sharp corners in the casting, fillets are made at the joints of the webs ribs and boss. The holes in the boss and base are small and can be easily drilled, and so core holes are not used in this case.

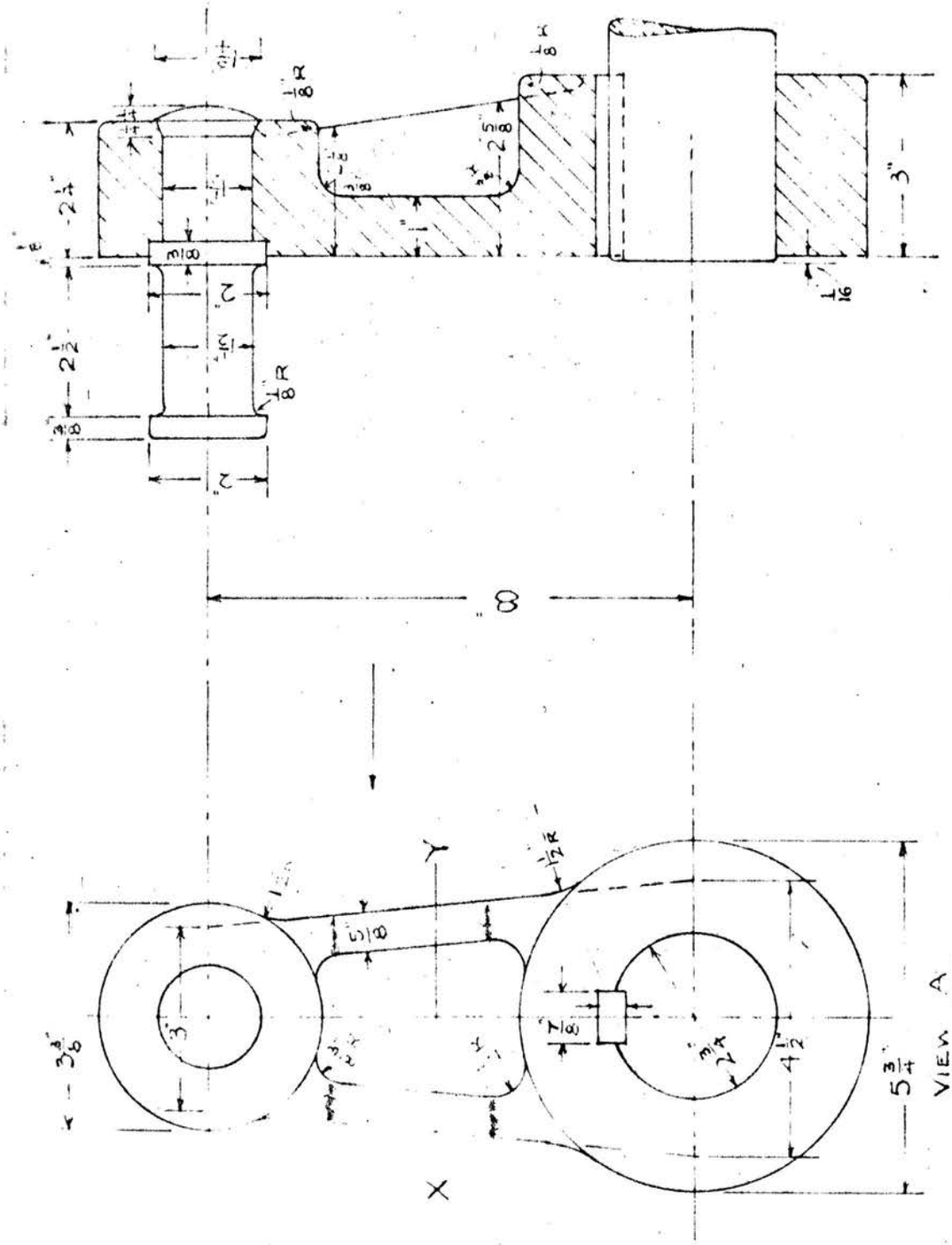
The next job was the Cast Iron Crank shown in Fig. 17. This involves most of the processes in the previous jobs but in this case the bosses are cut out from the solid instead of being turned. The job was drawn out with the contraction sizes and allowances for machining as before. The bottom plate was then prepared and finished on the inside to be ready for fitting the bosses. The bosses were then cut from the solid and finished on the inside for fitting on the bottom plate. The bottom plate and bosses were then fitted. (The short ribs are indicated between the dotted lines on the drawing). The whole pattern was then cut to shape outside with the bandsaw and finished with spokeshave and gouges. Core prints were then made and fitted to the centre of the bosses to finish the pattern.

The next job was to make a pattern for the Locomotive Crosshead shown in Figure 18. This introduced the method of making patterns in halves which in many cases of



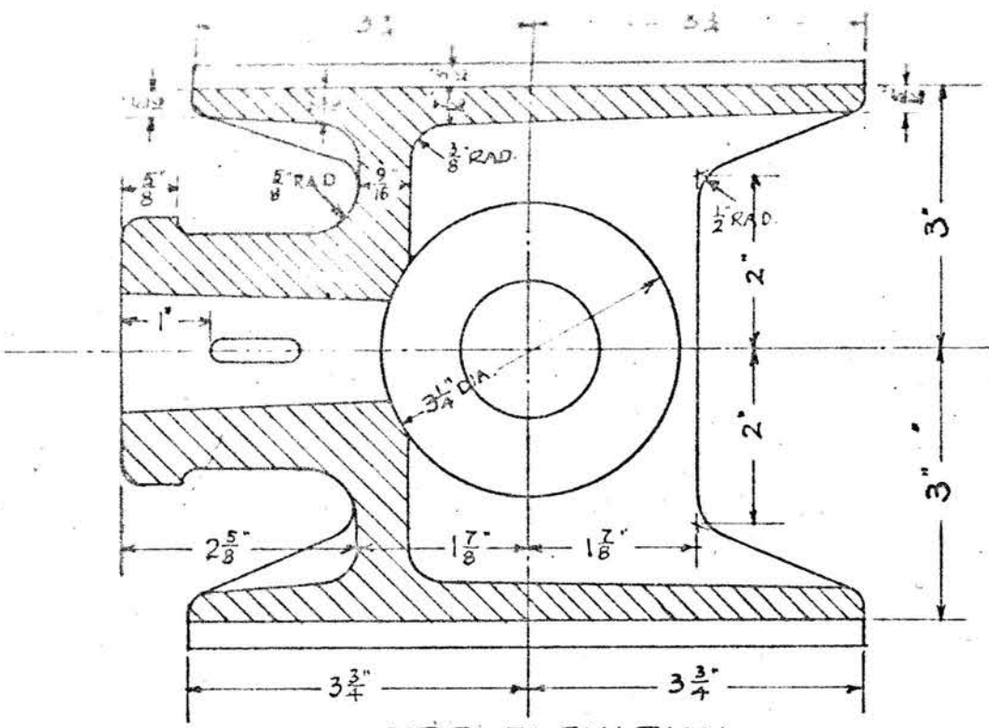
CAST IRON BRACKET.

FIG 16

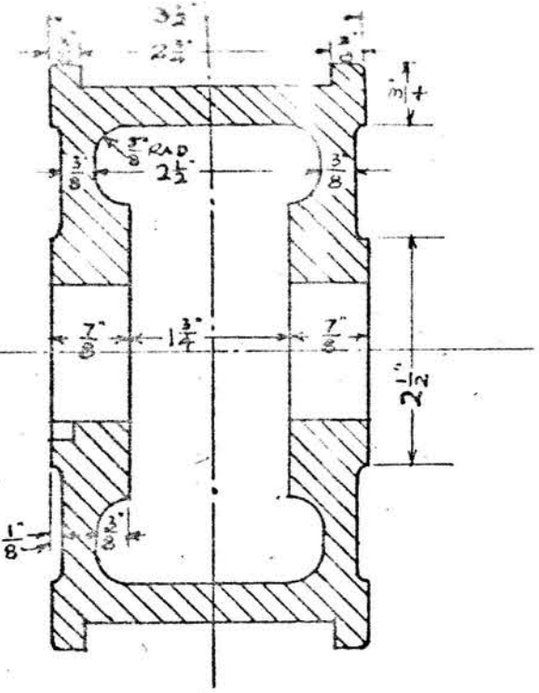


CAST IRON CRANK

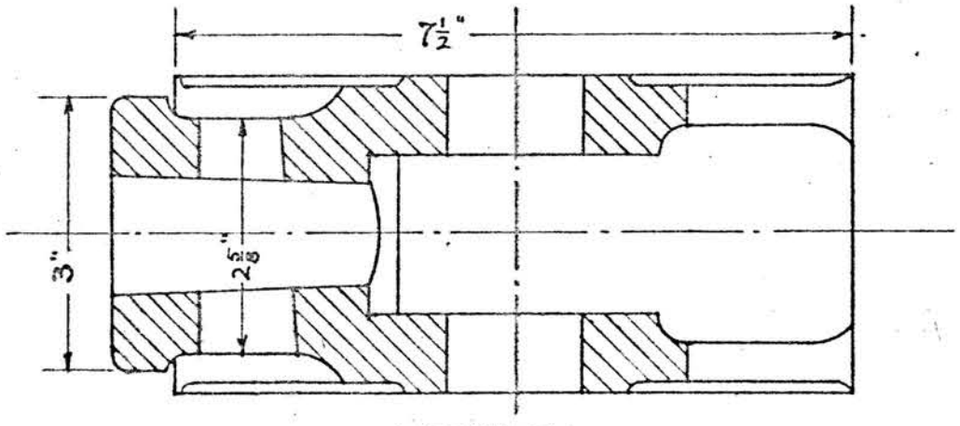
FIG. 17.



SIDE ELEVATION.



END ELEVATION.



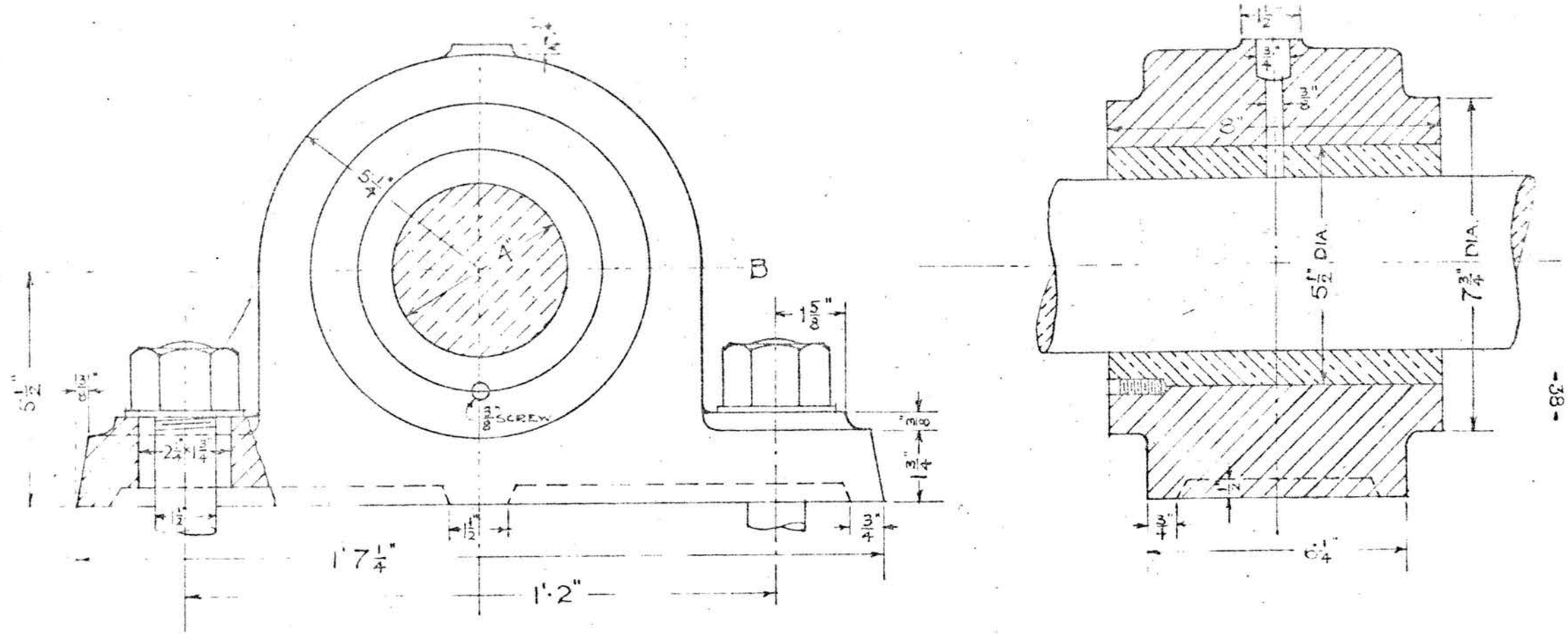
PLAN.

LOCOMOTIVE CROSSHEAD.

FIG. 18.

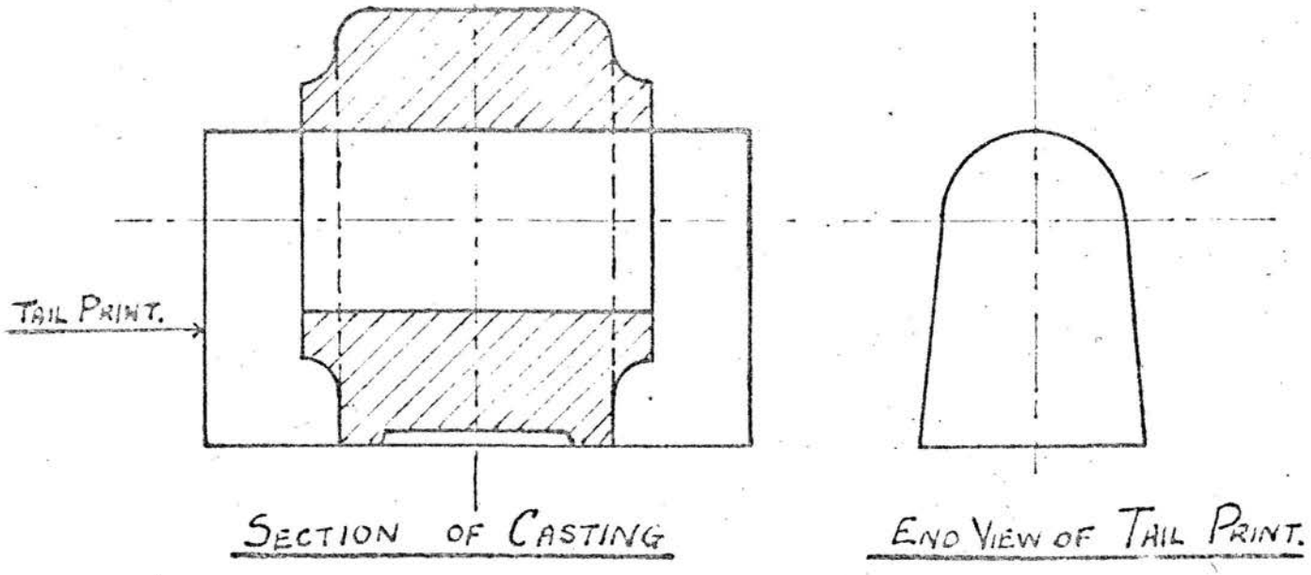
more complicated machine parts, greatly facilitates the moulding. The timber for the pattern was prepared as in the previous jobs from drawings made with contraction sizes and having the usual machining allowances. In this case however each half of the pattern was made separately and when these were completed dowel pins were fitted in the sections, and these hold the two halves together. This method allows each half of the pattern to be moulded separately and so makes it much easier to prepare the mould for the casting.

The last job was to make a pattern for the Cast Iron Bearing shown in Fig. 19. This job introduced what are known as tail-prints. The pattern was drawn out, made, and built up as in previous jobs and the tail-prints were built up with the pattern. Sketch 19(a) shows the tail-prints. Their purpose is to facilitate moulding and to avoid cutting down the sand in the mould to allow the pattern to be withdrawn. From sketch 19(a) it will be seen that if tail-prints were not used and ordinary core prints used instead, the core required for the hole through the bearing would be longer than the width of the mould. Consequently it would be impossible to insert the core in the mould. When tail-prints are used the space left when the pattern is withdrawn from the sand is sufficient to allow the core to be inserted and a making-up piece is prepared which allows the mould to be made according to the required drawing and so the casting will be as required. It will be noticed that the holes in the base for the holding down bolts are oval 2¼" x 1⅝" and so these holes are easier cored than bored. For these holes core prints had to be prepared and as a further exercise for the subjects core boxes for the making of the cores themselves had to be made.



CAST IRON BEARING.

FIG 19.



CAST IRON BEARING.

FIG 19(a).

DRAUGHTSMANSHIP.

The third section of Engineering Ability is the work done by the subjects in the drawing office. The tests here consist of the work of the classes in Engineering Drawing both Mechanical and Geometrical over a period of some three hundred hours. Being the work done under ordinary drawing office class conditions over a long period of time and the results being taken on the actual merit shown, the estimate of the ability of the subjects in this should be very reliable. Even in the case of subjects with some previous experience, by the end of the time considered the advantage works itself out, as subjects with aptitude for draughtsmanship but without previous experience are soon able to make as good results as those others. On the other hand the poor draughtsman is still discernible, even if he has had previous experience, as his work shows lack of finish, coarseness of lines, and untidiness quite markedly. The work done was elementary to begin with; simple exercises to teach the use and handling of drawing instruments with a variety of geometrical drawing exercises cover the first part of the work. Afterwards the subjects are introduced to simple machine parts, bolts and nuts, rivets keys and cotters and other simple details. Then drawings such as those shown in Figures 16-19 are introduced, the drawings becoming more difficult and complicated as progress is made and finally design and drawing of more difficult machines such as hydraulic cylinders, steam cylinders, Spur and Bevel gears, Worm and Wheel, propeller blades and so on have to be done. All work done is examined; marked and evaluated and the

evaluation taken as an estimate of the subjects capacity in draughtsmanship. It should be noted here that in the estimate of draughtsmanship the results of class examinations were taken into account as well as the actual performance of the drawings in the Drawing Office. On this account it is possible that there is an intelligence factor introduced which may show itself in the correlation of Intelligence with Mechanical Drawing, and because of which there may be a higher correlation in the present investigation than is obtained by other investigators who have correlated Intelligence with Mechanical Drawing itself and found that the correlation coefficients in such cases are low.

EVALUATION OF THE TESTS.

Keeping in view the purpose of the investigation, the author found it necessary to evaluate the tests performed so as to be able to find the correlations between the factors under consideration and he proposes at this stage to state the methods adopted for this purpose. First of all with regard to the Intelligence Test, it was difficult to deal with this in the ordinary way by putting the subjects into Age groups according to Equivalent Mental Age determined from the Test Norms. The Norms available are for youths in attendance at various types of schools and these do not seem to the author to be applicable to the subjects in the present investigation. The method adopted therefore was to treat the results of the Intelligence Tests as an estimate of intelligence and to reduce it to a percentage value which value was used in finding the correlation of Intelligence with the other tests. The ages of the subjects were mostly around 18 to 22 years. There are a few over 22 and a few under 18. As all are over 16 years of age it seems to be not unreasonable to assume that all the subjects have reached the stage when growth of intelligence has ceased (Dr. P.B. Ballard -Group Tests of Intelligence- page 150) and that the percentage obtained in the Intelligence Test is a value that may be used in correlating intelligence with the other tests.

THE CUBE-BUILDING TEST was evaluated by Link's Time-Error score formula

$$\frac{27 - E}{T}$$

27 = Number of small cubes.
where E - Uncorrected Errors
T - Time taken to build cube in minutes.

There were various methods adopted in building the cube and

these were noted. As has been already pointed out the method of building up the large cube is non-quantitative and may depend on intelligence—on the subject's grasp of what is required and on his systematic or non systematic working in building the cube. Link allowed his subjects to demolish the 3" cube and build it up again. In the present test with spatial perception as the object in view the subjects are not given the 3" cube completed but are simply presented with the 27 — 1" cubes in a standardised position with all the black faces on the small cubes exposed to the glance of the subject. The subject is then asked to build a 3" cube complete with every one of the faces of the cube black. The subject is thus compelled to build the cube using spatial perception in placing the respective small cubes in their positions in the larger cube. Other factors such as manipulation and logical reasoning, of course play their part but the author feels justified in taking the test as one for spatial perception. The methods adopted by the subjects were chiefly:-

(a) The building of each horizontal section one after, and on, the other.

(b) The building of each vertical section separately and placing them together when complete.

Some subjects used a combination of both methods (a) and (b). Others again built the cube in a haphazard manner picking up any small cube and finding a place for it in the construction already completed.

The subjects using methods (a) or (b) were generally quicker than the others in completing the large cube and had fewer errors, corrected and uncorrected; it was evident that they had a clearer conception of the required cube.

The best results were given by those building the bottom horizontal section then the middle horizontal section on top of that, and finishing with the top horizontal section. In one or two exceptional cases the time taken was very little more than that required for the actual manipulation of the small cubes in building the large one (about a minute and a half) and on the other hand some subjects were m ore than ten minutes trying to get the cube built and were unsuccessful even then in completing it.

THE FORMBOARD TESTS were evaluated in a manner very similar to the cube-building test. Here the subject was presented with a number of metal pieces which had to be placed in position on the form-board. The subject who does the test perfectly will look at the formboard then examine the metal pieces and select the piece suitable for a particular space on the formboard. He will handle only the number of pieces required to fill all the spaces, placing the pieces correctly on the proper spaces at the first trial. If any pieces are placed wrongly and require to be altered an increase in the t[illegible] to complete the test takes this into account and any pieces placed wrongly, and not corrected, count as errors. Thus, using an equation as before,

$$\text{Estimate of Spatial Perception} = \frac{\text{Number of pieces to be placed} - \text{Errors Uncorrected}}{\text{Time taken in minutes}},$$

we get a means of evaluating this test. Four formboard tests were performed by each subject and the estimate of each of these tests were taken and averaged, the average being taken as the value of the performance in the tests for the purpose of correlation. The same evaluation was made for every subject in the investigation. Most of the subjects attempted to select the proper piece suitable for the spaces to be filled but there were subjects who resorted to trial and error methods. These latter took much longer

times to perform the tests as would be expected since every false move adds to the time required to correctly complete the formboard test.

THE STRIP-BUILDING TEST is evaluated by ranking the performance inversely as the time taken. The subjects performed this test in various ways. Some selected the strips in pairs beginning with the shortest and longest together and proceeded to fill the tray in this way. Others filled one row beginning with the shortest or longest piece first, then proceeded to fill in the corresponding strips in the other row. Again some subjects filled in one row in irregular order and proceeded by trial and error to fill in the other row. While others proceeded by methods which were combinations in various forms of the aforesaid methods. Whatever method was adopted did not make much difference in the time taken and consequently manipulation in this test would appear to be as much a factor as spatial perception. In order to get an evaluation which was comparable with that in the cube-building and formboard tests the estimate was taken as

$$\frac{\text{Number of Strips}}{\text{Time in minutes.}}$$

In the test for Accuracy of Movement in which the subject is required to move the pencil between two brass strips connected up in an electrical circuit with an electric bell, the method of evaluating is dependent on the distance moved without touching the strips. In the test it is possible for the subject to move a distance of 15 cms. Perfect accuracy of movement in each case means that the subject is able to move this distance. The value taken then is Possible distance, less the distance still to go when the bell rings indicating contact to have taken place. Six observed tests were done by each subject, three with the

right hand and three with the left hand. The following formula was used in evaluating.

$$\frac{D - D_{/}}{N} = \text{Accuracy of Movement}$$

where D = Possible distance which each subject could go:- 6 x 15 cm.

$D_{/}$ = Distance still to go when contact took place

= Sum of readings at contact of pencil with brass strip

N = Number of Tests = 6 .

Thus an average value over the six tests was obtained. In this test co-ordination of hand and eye is most important, but in observing the tests the author suspected a nervous condition in many of the subjects due to the shakiness of the hand holding the pencil. He found in some of the younger subjects great steadiness in performing the tests and consequently some of the results were very good in these cases. Suspecting that cigarette smoking might have something to do with the phenomenon, he put the question at the end of the tests to the subjects as follows:- "You do not smoke?" or "You are a heavy smoker?" according to the impression got during the performance of the tests. In nearly every case, in fact in every case but one, the answer given agreed with the opinion already formed by the author. The one case in which the subject's hand showed greater steadiness and which seemed to the writer to indicate a non-smoker was a subject whose job in the works was in the drawing office and on that account he had probably more control over his hands for a test such as was being observed than the others, due to the nature of his work requiring this control.

The next test for accuracy of movement was performed with the subjects blindfolded. The movement in this test was confined in direction by the slot between the two metre sticks and the subject was required to move the pencil to a point determined by the position of the brass stop, the position of the brass stop being in the control of the author. Muscle strain is the principle factor in determining the movement but there were some subjects who introduced other factors. For example a very slow movement suggested the introduction of a time factor—the subject endeavouring to judge the time taken in moving the standard distance and judging the same time in moving the judged distance. Again a jerky movement suggested movement in terms of length, the subject moving in steps of say 10cms. at a time and judging the standard movement in this way and imitating the method in the judged test. On questioning the subjects this was found to be correct and these subjects were then asked to repeat the test judging movement rather than time and distance. Better estimates of movement resulted. The evaluation of the results was made by taking the estimate of accuracy of movement inversely as the error in movement. Three tests were done with each hand as before and the following formula used:-

$$\text{Accuracy of Movement} = \frac{\text{Exact distance to be moved (cms)}}{\text{Total Error in Movement (cms)}}$$

In the tests for Engineering Ability, the evaluation of the results was the same in each subdivision. In draughtsmanship each drawing was corrected and marked and at the end of each term an examination was given. The

final estimate of draughtsmanship being reckoned on the results of the work done as exercises in the drawing office and the results of end of term examinations. In patternmaking each job was examined on completion and a mark given in accordance with the neatness and accuracy of the job. At the end of the course a timed job is done by each subject individually and independently and this was examined and a mark given for it. The whole of the work done was then considered and the total marks obtained added together and taken as the estimate of proficiency in patternmaking. In the workshop each turning and fitting job was examined and a value assessed. These marks together with marks in an examination and a timed test were taken as the basis for the final mark awarded and used in this investigation.

THE RESULTS.

From the data collected in the investigation, the author evaluated all the tests, and the results are tabulated on the following pages. Instead of giving the names of each individual subject he has used the following notation :-

GROUP 1. subjects are "A" "B" "C" ___etc. to "d".

GROUP 2. " " "I" "II" "III" "IV" etc. to"XXVII".

GROUP 3. " " "1" "2" "3" "4" etc. to "32".

IN Group 1. the subject "S" is far above the average in practically every one of the tests. He attended an Elementary school till he was 15, and went into the works from there to serve his apprenticeship. At his work he is smart and capable and is placed very high in the estimate of engineering ability. Subject "U" did badly in all the tests, but in his work he is exceedingly capable. At the request of the author the Works Superintendent asked for a report on this subject from the foreman. The report was excellent and was emphasised later by the foreman in an interview with the author. Subject "b" had a very low mark in the Intelligence test. With this subject there is a marked lack of initiative which the author noticed in the performance of all his tests,the subject requiring to be helped at the outset but performing the tests satisfactorily thereafter. An interview with the foreman confirmed the existence of this lack of initiative. Further enquiry showed that this subject had been brought up in circumstances where he was not well looked after ,and on account of parental neglect he was often off school and made little progress while there. After "b"did the Spatial Perception tests in which he seemed to be very interested, the author in talking with him found that he spent a lot of his leisure time solving puzzles and that anything in the nature of a puzzle interested him. The remainder of the subjects in Group 1. do not call for comment. Some are above the average, some below,while others vary with the tests.

In Group 2. subjects "VI", "X","XVIII",and "XXVII" are all very good consistently in all the tests while "III" and "XII" are very poor. These latter two subjects failed to complete the College course. The other subjects in this group were all average subjects.

In Group 3. subjects "23" and "30" were very good consistently while "20" "21" and "31" were all very poor throughout the tests. Each of these three latter subjects had come to College straight from school and each did fairly well in the Intelligence tests. Lack of interest in their workwas evident in College and a similar lack of interest would account for their low marks in the battery of tests.

It will be noticed that the averages for Group 2. in each of the tests is higher than the averages for the other groups, and the averages for Group3. are higher than those for Group 1. This is probably due to the subjects in Group 1. being as a rule, away from school about the ages of 14 or 15 years while the majority of the subjects in the other groups would probably be at school at least a year or two longer. The longer preliminary education together with their technical training would be an advantage in the performance of tests such as those used in the investigation.

In dealing with results, the author took the results of each group separately. In Groups 1. and 2.he found the correlations between the individual teststo see if weighting factors should be used. Group 3.was used as a control group.

On page 57 are tabulated the preliminary correlations.

GROUP 1.

Result of Intelligence Test and Estimate of Engineering Ability.

Subject	Age	Intelligence	Estimate of Eng. Abil.
"A"	Yrs-Mos. 16 -3	45.2	5.0
"B"	17 - 7	39.5	7.0
"C"	17 - 3	65.1	7.5
"D"	15	26.7	5.0
"E"	15 -11	54.2	4.5
"F"	15 - 4	47.0	4.9
"G"	16	40.3	5.8
"H"	17 - 2	66.1	4.9
"I"	16	49.2	6.8
"J"	16 - 8	54.0	5.5
"K"	18	55.2	4.5
"L"	17 - 8	44.0	4.8
"M"	18 - 3	53.1	4.0
"N"	20 - 7	51.2	4.2
"O"	20 - 2	73.5	9.0
"P"	19 - 2	46.8	7.0
"Q"	19	53.0	7.1
"R"	17 - 8	66.8	6.1
"S"	19	89.0	8.5
"T"	21 - 2	34.0	5.3
"U"	18 - 2	37.0	8.6
"V"	18 - 1	59.3	5.3
"W"	19	54.7	5.1
"X"	19 -10	54.2	5.2
"Y"	22	54.2	5.4
"Z"	18	37.0	7.2
"a"	19	67.8	5.2
"b"	20 - 3	12.0	4.0
"c"	22 - 2	56.2	7.8
"d"	22 - 2	64.5	8.2
Averages		51.69	6.046

GROUP 1.

Results of Tests for Spatial Perception and Accuracy of Movement.

Subject	Cube-Building	Form-boards	Strip-Building	Total for Spat. Perc.	Accuracy of Movement (1)	(2)	Total
"A"	1.7	1.8	3.5	2.3	15.4	7.4	11.4
"B"	3.3	2.7	5.3	3.8	11.6	13.5	12.7
"C"	8.4	4.7	8.1	7.1	10.5	5.4	8.0
"D"	4.4	1.9	4.8	3.7	11.6	7.3	9.5
"E"	7.0	2.6	9.0	6.2	11.3	12.6	11.9
"F"	2.3	4.4	5.7	4.1	17.8	13.1	15.5
"G"	6.8	4.2	10.1	7.0	18.7	12.3	15.5
"H"	5.0	4.4	7.0	5.5	18.1	7.9	13.0
"I2	8.5	7.7	9.6	8.6	18.5	10.0	14.3
"J"	3.2	4.8	5.0	4.3	13.8	6.8	10.3
"K"	7.7	3.1	5.6	5.5	16.6	9.1	12.9
"L"	8.7	4.7	8.1	7.2	28.6	10.4	19.5
"M"	2.8	3.8	7.2	4.6	14.1	8.3	11.2
"N"	3.0	5.5	4.0	4.2	14.9	7.5	11.2
"O"	6.4	5.7	8.3	6.8	12.8	9.9	11.4
"P"	12.3	6.0	10.4	9.6	20.0	10.9	15.5
"Q"	9.0	3.8	8.2	7.0	12.3	10.7	11.5
"R"	6.3	3.7	7.7	5.9	16.7	6.5	11.6
"S"	18.9	6.6	12.8	12.8	39.0	9.1	24.0
"T"	2.7	5.0	5.1	4.3	17.9	9.5	13.7
"U"	2.2	2.5	4.5	3.1	10.3	9.3	9.8
"V"	4.7	2.9	4.9	4.2	16.7	10.0	13.4
"W"	6.5	3.4	9.2	6.4	29.4	10.6	20.0
"X"	4.5	5.8	5.2	5.2	16.1	9.4	12.8
"Y"	5.2	3.6	7.7	5.5	18.5	10.6	14.6
"Z"	7.9	2.5	7.0	5.8	14.1	9.4	11.8
"a"	5.2	7.9	6.9	6.7	23.8	11.8	17.8
"b"	7.2	4.3	8.9	6.8	12.7	9.7	11.2
"c"	5.9	3.9	6.3	6.1	21.8	11.1	16.5
"d"	14.5	7.3	12.3	11.4	14.7	11.0	12.9
Averages	6.41	4.37	7.35	6.06	16.61	9.7	13.18

GROUP 2.

Result of Tests for Intelligence and Engineering Ability.

Subject	Age Yrs.-Mos.	Intelligence	Engineering Ability			
			Drawing	Pattern making	Workshop	Total for Eng. Abil.
"I"	18-10	[illegible].0	76	89	89	85
"II"	18	72.5	64	68	60	64
"III"	19	53.6	13	24	34	24
"IV"	17-11	60.0	14	46	62	54
"V"	19-1	65.3	71	64	60	65
"VI"	16-8	80.2	75	85	81	80
"VII"	19-4	71.0	77	93	89	86
"VIII"	20-7	65.0	50	52	76	59
"IX"	20-10	41.2	36	61	73	55
"X"	18-4	81.6	79	95	84	87
"XI"	19-1	77.0	71	65	73	70
"XII"	22-9	25.0	30	23	17	23
"XIII"	21-10	66.6	57	95	69	74
"XIV"	17-10	57.0	87	96	88	84
"XV"	18-9	62.5	41	68	50	50
"XVI"	20	80.0	81	92	60	78
"XVII"	17-6	70.5	71	77	59	69
"XVIII"	18-8	83.0	94	78	64	79
"XIX"	17-9	85.5	71	80	76	76
"XX"	18	73.1	76	88	86	83
"XXI"	18-9	75.0	87	89	91	89
"XXII"	20-4	58.2	62	69	69	67
"XXIII"	22-5	67.2	69	78	82	76
"XXIV"	18	54.1	56	79	67	67
"XXV"	17-4	52.0	55	83	65	69
"XXVI"	20-6	53.6	65	67	71	64
"XXVII"	21-4	78.0	79	58	64	67
Averages		67.5	64.5	72	68.8	68.2

GROUP 2.

Results of Tests for Spatial Perception and Accuracy of Movement.

Subject	Cube-Building	Form-boards	Strip-Building	Total for Spat.Perc.	Accuracy of Movement. (1)	(2)	Total
"I"	9.5	3.2	10.1	7.6	16.6	10.1	13.8
"II"	9.5	6.0	7.2	7.6	24.0	9.2	16.6
"III"	2.1	3.0	4.0	3.0	16.2	10.7	13.5
"IV"	10.0	6.8	8.2	8.3	18.0	10.4	14.2
"V"	7.0	8.0	12.0	9.0	17.7	9.9	13.8
"VI"	12.6	15.0	11.3	13.0	30.0	10.4	20.2
"VII"	10.4	7.5	9.1	9.0	27.8	9.4	18.6
"VIII"	10.8	10.4	8.3	9.8	14.4	8.7	11.5
"IX"	5.6	4.2	7.1	5.6	14.8	7.4	11.1
"X"	12.5	8.8	13.7	11.6	31.0	10.4	20.7
"XI"	10.4	4.8	9.2	8.1	19.1	8.1	13.6
"XII"	3.2	3.0	4.9	3.7	15.4	9.5	12.5
"XIII"	8.7	7.6	10.7	9.0	19.7	8.1	13.9
"XIV"	9.9	8.6	11.0	9.8	27.0	9.8	18.4
"XV"	6.9	5.3	7.0	6.4	13.8	10.7	12.2
"XVI"	10.8	7.5	10.4	9.6	24.5	10.8	17.6
"XVII"	6.3	4.5	8.9	6.6	19.6	9.7	14.6
"XVIII"	10.4	9.0	9.8	9.7	18.0	10.5	14.3
"XIX"	6.8	5.5	7.7	6.6	16.5	11.6	14.1
"XX"	4.9	5.0	9.7	6.5	17.2	9.0	13.1
"XXI"	8.3	9.5	11.3	9.7	29.4	9.5	19.5
"XXII"	2.5	5.4	8.0	5.3	13.5	9.8	11.6
"XXIII"	6.6	8.7	9.5	8.3	17.0	7.9	12.5
"XXIV"	5.7	4.1	7.3	5.7	20.8	10.2	15.5
"XXV"	5.2	5.8	7.1	6.0	14.8	10.6	12.7
"XXVI"	3.2	5.5	9.0	5.9	18.5	9.1	13.8
"XXVII"	15.0	9.7	12.0	12.2	26.4	9.1	17.7
Averages	7.92	6.75	9.048	7.9	20.03	9.6	14.9

GROUP 3

Result of Intelligence Test.

Subject	Age Yrs.-Mos.	Intelligence
"1"	22 - 11	69.0
"2"	21 - 8	58.0
"3"	23 - 6	55.5
"4"	22	70.5
"5"	18 - 1	84.5
"6"	20	54.2
"7"	19 - 1	68.6
"8"	20 - 3	73.8
"9"	20 - 6	49.1
"10"	20 - 3	68.2
"11"	20 - 5	73.6
"12"	24	63.5
"13"	23 - 10	36.4
"14"	17 - 9	57.6
"15"	22 - 5	65.6
"16"	19 - 8	52.6
"17"	19 - 6	71.0
"18"	23 - 7	46.8
"19"	21 - 1	73.0
"20"	17 - 4	68.1
"21"	16 - 8	67.4
"22"	21	67.4
"23"	22 - 1	90.0
"24"	19 - 6	69.0
"25"	22	68.0
"26"	20	59.0
"27"	19 - 2	62.0
"28"	23 - 2	48.0
"29"	19	55.0
"30"	17 - 7	86.5
"31"	16 - 4	78.1
"32"	23	59.6
	Average	64.55

GROUP 3.

Results of Tests for Spatial Perception and Accuracy of Movement.

Subject	Cube-Building	Form-boards	Strip-Building	Total for Spat.Perc.	Accuracy of Movement. (1)	(2)	Total
"1"	7.2	6.5	9.1	7.6	23.0	7.6	15.3
"2"	12.5	5.0	8.1	8.5	16.7	8.5	12.6
"3"	5.0	4.1	6.9	5.3	14.0	8.9	11.5
"4"	7.6	5.4	7.2	6.7	18.3	7.6	12.9
"5"	4.6	3.3	5.8	4.6	16.3	6.2	11.3
"6"	12.8	7.6	10.5	10.3	17.5	9.5	13.5
"7"	7.9	10.1	9.5	9.2	20.0	10.3	15.2
"8"	4.5	3.4	7.3	5.1	16.1	10.4	13.3
"9"	3.9	3.2	4.2	3.8	18.5	8.8	13.6
"10"	8.3	8.7	11.0	9.3	25.0	9.6	17.3
"11"	6.1	5.1	7.0	6.1	20.6	10.1	15.4
"12"	8.4	6.2	9.4	8.0	18.9	8.6	13.8
"13"	1.8	3.6	6.9	4.1	19.5	8.5	14.0
"14"	2.6	3.1	4.9	3.5	16.3	9.8	13.1
"15"	7.1	5.8	9.9	7.6	20.9	10.9	15.9
"16"	6.3	7.3	10.0	7.9	22.0	9.4	15.7
"17"	12.5	8.8	12.3	11.2	21.0	7.5	14.3
"18"	6.3	4.9	7.0	6.1	10.9	8.9	9.9
"19"	7.1	5.9	8.5	7.2	25.0	8.7	16.9
"20"	3.3	3.1	5.0	3.8	20.0	10.4	15.2
"21"	3.2	3.3	3.7	3.4	14.0	8.3	11.2
"22"	8.2	4.1	9.9	7.4	18.5	8.0	13.3
"23"	13.0	7.7	13.7	11.5	13.8	8.4	11.1
"24"	6.3	4.3	7.3	6.0	18.9	9.5	14.2
"25"	5.8	4.9	6.4	5.7	14.8	8.0	11.4
"26"	8.4	7.0	9.4	8.3	18.2	7.2	12.6
"27"	1.5	3.0	4.2	2.9	14.7	8.0	11.3
"28"	5.6	4.9	7.3	5.9	19.8	9.2	14.5
"29"	5.8	3.9	7.8	5.8	16.2	9.8	13.0
"30"	13.3	8.7	11.7	11.3	19.5	7.9	13.7
"31"	4.0	4.7	5.0	4.6	15.8	11.1	13.5
"32"	7.9	8.6	10.8	9.1	18.9	8.0	13.5
Averages	6.8	5.5	8.05	6.8	18.2	8.85	13.5

The following table gives the preliminary correlations referred to on page 50.

r = Correlation Coefficient.
S.E. = Standard Error of r.
P.E. = Probable Error of r.

GROUP 1.

Correlation of :-	r	S.E.	P.E.
Intelligence and Cube-building	.460	.144	.097
" " Formboard Tests	.458	.144	.097
" " Strip-building	.390	.131	.092
" " Accy. of Move.(bld-fold.)	.433	.147	.098
" " " " "	-.090	.182	.122
Cube-building " Formboard Tests	.475	.141	.095
" " Strip-building	.855	.049	.033
" " Accy. of Move.(bld-fold.)	.497	.137	.093
" " " " "	.095	.181	.122
Formboard Tests and Strip-building	.490	.139	.093
" " " Accy.of Move.(bld-fold.)	.388	.155	.104
" " " " " "	.096	.181	.122
Strip-building " " " " (bld-fold.)	.460	.144	.097
" " " " " "	.285	.168	.113
Accy.of Move.(bld-fold.) and Accy.of Move.	.165	.177	.119
Engineering Ability and Cube-building.	.465	.132	.089
" " " Formboard Tests.	.314	.166	.112
" " " Accy. of Move (b.f.)	.0015	.182	.122
" " " " " "	.111	.180	.121

Table of preliminary correlations referred to on page 50.

r = Correlation Coefficient.

S.E. = Standard Error of r.

P.E. = Probable Error of r.

GROUP 2.

Correlation of :-	r	S.E.	P.E.
Intelligence and Cube-building	.608	.121	.082
" " Formboard Tests	.565	.131	.088
" " Strip-building	.586	.126	.085
" " Accy. of Move.(bld-fold)	.359	.168	.113
" " " " "	— .035	.192	.130
Cube-building " Formboard Tests	.674	.105	.071
" " Strip-building	.680	.104	.070
" " Accy. of Move.(bld-fold)	.651	.111	.075
" " " " "	.006	.193	.130
Formboard Tests and Strip-building	.670	.106	.072
" " " Accy. of Move.(bld-fold)	.551	.134	.090
" " " " " "	— .054	.192	.130
Strip-building " " " " (bld-fold)	.596	.124	.083
" " " " " "	— .021	.192	.130
Accy. of Move.(bld-fold)and Accy. of Move.	.092	.190	.121
Intelligence and Drawing	.510	.142	.096
" " Patternmaking	.193	.185	.125
" " Workshop	.298	.175	.118
Drawing and Patternmaking	.720	.092	.062
" " Workshop	.626	.121	.082
Patternmaking and Workshop	.815	.065	.044

An examination of the correlations on pages 57 and 58 suggested that the results so far obtained are such as to justify slumping the tests for Spatial Perception, Accuracy of Movement and (in Group 2.)Engineering Ability. This was done by averaging the results in Cube-building, Formboard tests, and Strip-building, and taking this average result as the value for Spatial Perception. Similarly for Accuracy of Movement, although in the test where the subject is required to move the brass pencil between the two brass strips the correlations are so very low that the test might be better to be omitted. The correlations so found are given in the table below for Groups 1. and 2. separately, and then for these groups together, and also for Group 3.

Correlations of :-	r.	S.E.	P.E.
		GROUP 1.	
Intelligence and Engineering Ability	.434	.148	.099
" " Spatial Perception	.496	.137	.092
" " Accuracy of Movement	.360	.159	.107
Eng. Ability and Spatial Perception	.478	.141	.095
" " " Accuracy of Movement	.122	.180	.121
Spat. Perception and Accy. of Movement	.530	.131	.088
		GROUP 2.	
Intelligence and Engineering Ability	.370	.166	.112
" " Spatial Perception	.655	.111	.075
" " Accuracy of Movement	.346	.170	.114
Eng. Ability " Spatial Perception	.630	.116	.078
" " " Accuracy of Movement	.445	.155	.104
Spat. Perception and Accy. of Movement	.680	.104	.070
		GROUP 3.	
Intelligence and Spatial Perception	.320	.159	.107
" " Accuracy of Movement	.014	.177	.199
Spat. Perception and Accy. of Movement	.246	.166	.112

After dealing with each of the groups separately, the author combined Groups 1. and 2. and proceeded to find the correlations for the new group thus formed. Both these groups had evaluations in Engineering Ability, and the correlations were as follows :-

Correlations of :-	r.	S.E.	P.E.
Intelligence and Engineering Ability	.419	.109	.073
" " Spatial Perception	.630	.080	.054
" " Accuracy of Movement	.40	.111	.075
Engineering Ability and Spatial Perception	.593	.086	.056
" " " Accuracy of Movement	.333	.118	.079
Spatial Perception and " " "	.633	.079	.054

Groups 1.,2.,and 3. were then combined and a new group with all the subjects in it was formed. The following correlations for this new group were then obtained :-

Correlations of :-	r.	S.E.	P.E.
Intelligence and Spatial Perception	.518	.077	.052
" " Accuracy of Movement	.294	.097	.065
Spatial Perception and " " "	.521	.078	.053

The correlations on this and the previous page show a very considerable degree of consistency. In all the sets of correlations except that for Group 3. the correlation of Spatial Perception and Accuracy of Movement is the highest. All the sets show the correlation of Intelligence and Spatial Perception to be next highest. In the three sets where there is Engineering Ability the correlation of Engineering Ability and Spatial Perception comes next. Except in Group 2. the correlation of Intelligence and Engineering Ability is next; then follow the correlation of Intelligence and Accuracy of Movement , and the correlation of Engineering Ability and Accuracy of Movement. That is to say the only correlations which would appear to be out of their order are those of Engineering Ability and Accuracy of Movement in Group 2.

and of Spatial Perception and Accuracy of Movement in Group 3. The correlation of Engineering Ability and Accuracy of Movement in Group 2. is 0·445. If this correlation were less than 0.346 it would be in the same order as in the other sets. Similarly the correlation of Spatial Perception and Accuracy of Movement in Group 3. —which is 0.246 — would require to be greater than 0.320 to bring it into the same order as in the other sets.

On pages 62-78 are shown the Partial Correlation Coefficientsfor Groups 1.,2., and 3. and for Groups 1.and 2. together and Groups 1.,2.,and 3. together. These Partial Correlation Coefficients are summarised on page 79.

Partial Correlation Coefficients of Intelligence, Engineering Ability, Spatial Perception and Accuracy of Movement.

GROUP 1.

Corr. Coefft. of Intelligence and Eng. Ability = r_{12} = 0·434

" " " " " Spat. Percept. = r_{13} = 0·496

" " " " " Accy. of Move. = r_{14} = 0·360

" " " Eng. Ability and Spat. Percept. = r_{23} = 0·478

" " " " " Accy. of Move. = r_{24} = 0·122

" " " Spat. Percept." Accy. of Move. = r_{34} = 0·530

$$\Delta = \begin{vmatrix} r_{11} & r_{12} & r_{13} & r_{14} \\ r_{21} & r_{22} & r_{23} & r_{24} \\ r_{31} & r_{32} & r_{33} & r_{34} \\ r_{41} & r_{42} & r_{43} & r_{44} \end{vmatrix}$$

$$\Delta = \begin{vmatrix} 1.00 & .434 & .496 & .360 \\ .434 & 1.00 & .478 & .122 \\ .496 & .478 & 1.00 & .530 \\ .360 & .122 & .530 & 1.00 \end{vmatrix}$$

Partial Correlation Coefficients. GROUP 1. (Continued).

$$\Delta_{11} = \begin{vmatrix} 1.00 & .478 & .122 \\ .7715 & .1313 & \\ .478 & 1.00 & .530 \\ .1313 & .7191 & \\ .122 & .530 & 1.00 \end{vmatrix} = .53755$$

$$\Delta_{22} = \begin{vmatrix} 1.00 & .496 & .360 \\ .7540 & -.0971 & \\ .496 & 1.00 & .530 \\ -.0971 & .7191 & \\ .360 & .530 & 1.00 \end{vmatrix} = .42225$$

$$\Delta_{33} = \begin{vmatrix} 1.00 & .434 & .360 \\ .8116 & -.3071 & \\ .434 & 1.00 & .122 \\ -.3071 & .9851 & \\ .360 & .122 & 1.00 \end{vmatrix} = .70526$$

$$\Delta_{44} = \begin{vmatrix} 1.00 & .434 & .496 \\ .8116 & -.2855 & \\ .434 & 1.00 & .478 \\ -.2885 & .7715 & \\ .496 & .478 & 1.00 \end{vmatrix} = .54392$$

$$\Delta_{12} = \begin{vmatrix} .434 & .478 & .122 \\ .1969 & .13134 & \\ .496 & 1.00 & .530 \\ -.0971 & .7191 & \\ .360 & .530 & 1.00 \end{vmatrix} = .15434$$

Partial Correlation Coefficients. GROUP 1. (Continued).

$$\Delta_{13} = \begin{vmatrix} .434 & 1.00 & .122 \\ -.2885 & .4709 & \\ .496 & .478 & .530 \\ -.1116 & .4133 & \\ .360 & .122 & 1.00 \end{vmatrix} = \frac{-.06675}{.478} = \underline{-.13965}$$

$$\Delta_{14} = \begin{vmatrix} .434 & 1.00 & .478 \\ -.2885 & +.7715 & \\ .496 & .478 & 1.00 \\ -.1116 & .13134 & \\ .360 & .122 & .530 \end{vmatrix} = \frac{.04819}{.478} = \underline{.1008}$$

$$\Delta_{23} = \begin{vmatrix} 1.00 & .434 & .360 \\ .2627 & .05794 & \\ .496 & .478 & .530 \\ -.1116 & .4133 & \\ .360 & .122 & 1.00 \end{vmatrix} = \frac{.114063}{.478} = \underline{.2387}$$

$$\Delta_{24} = \begin{vmatrix} 1.00 & .434 & .496 \\ .2627 & .1969 & \\ .496 & .478 & 1.00 \\ -.1116 & .13134 & \\ .360 & .122 & .530 \end{vmatrix} = \frac{.05646}{.478} = \underline{.1181}$$

$$\Delta_{34} = \begin{vmatrix} 1.00 & .434 & .496 \\ .8116 & -.2885 & \\ .434 & 1.00 & .478 \\ -.3071 & .4709 & \\ .360 & .122 & .530 \end{vmatrix} = \underline{.29359}$$

Partial Correlation Coefficients, GROUP 1, (Continued).

$$b_{12.34} = \frac{\Delta_{12}}{\Delta_{11}} = \frac{\cdot 15434}{\cdot 5375} = \cdot 28714 \text{ say } \cdot 287$$

$$b_{13.24} = \frac{\Delta_{13}}{\Delta_{11}} = \frac{-.13965}{\cdot 5375} = -\cdot 25991 \text{ say } -\cdot 260$$

$$b_{14.23} = \frac{\Delta_{14}}{\Delta_{11}} = \frac{\cdot 1008}{\cdot 5375} = \cdot 18753 \text{ say } \cdot 188$$

$$b_{21.34} = \frac{\Delta_{12}}{\Delta_{22}} = \frac{\cdot 15434}{\cdot 42125} = \cdot 3664 \text{ say } \cdot 366$$

$$b_{23.14} = \frac{\Delta_{23}}{\Delta_{22}} = \frac{\cdot 2387}{\cdot 42125} = \cdot 3666 \text{ say } \cdot 367$$

$$b_{24.13} = \frac{\Delta_{24}}{\Delta_{22}} = \frac{\cdot 1181}{\cdot 42125} = \cdot 28035 \text{ say } \cdot 280$$

$$b_{31.24} = \frac{\Delta_{13}}{\Delta_{33}} = \frac{-.13965}{\cdot 7053} = -\cdot 198$$

$$b_{32.14} = \frac{\Delta_{23}}{\Delta_{33}} = \frac{\cdot 2387}{\cdot 7053} = \cdot 33843 \text{ say } \cdot 338$$

$$b_{34.12} = \frac{\Delta_{34}}{\Delta_{33}} = \frac{\cdot 29359}{\cdot 7053} = \cdot 41626 \text{ say } \cdot 416$$

$$b_{41.23} = \frac{\Delta_{14}}{\Delta_{44}} = \frac{\cdot 1008}{\cdot 5439} = \cdot 18533 \text{ say } \cdot 185$$

$$b_{42.13} = \frac{\Delta_{24}}{\Delta_{44}} = \frac{\cdot 1181}{\cdot 5439} = \cdot 21713 \text{ say } \cdot 217$$

$$b_{43.12} = \frac{\Delta_{34}}{\Delta_{44}} = \frac{\cdot 29359}{\cdot 5439} = \cdot 53979 \text{ say } \cdot 540$$

Partial Correlation Coefficients. GROUP 1. (Continued).

The Regression Equations are :-

$$\bar{x}_1 = b_{12.34}\, x_2 + b_{13.24}\, x_3 + b_{14.23}\, x_4$$

$$= \underline{\underline{\cdot 287x_2 - \cdot 260x_3 + \cdot 188x_4}}$$

$$\bar{x}_2 = b_{21.34}\, x_1 + b_{23.14}\, x_3 + b_{24.13}\, x_4$$

$$= \underline{\underline{\cdot 366x_1 + \cdot 567x_3 + \cdot 280x_4}}$$

$$\bar{x}_3 = b_{31.24}\, x_1 + b_{32.14}\, x_2 + b_{34.12}\, x_4$$

$$= \underline{\underline{-\cdot 198x_1 + \cdot 338x_2 + \cdot 416x_4}}$$

$$\bar{x}_4 = b_{41.23}\, x_1 + b_{42.13}\, x_2 + b_{43.12}\, x_3$$

$$= \underline{\underline{\cdot 185x_1 + \cdot 217x_2 + \cdot 540x_3}}$$

The Partial Correlation Coefficients then are :-

$$r_{12.34} = \sqrt{b_{12.34} \times b_{21.34}} = \sqrt{\cdot 287 \times \cdot 366} = \underline{\cdot 324}$$

$$r_{13.24} = \sqrt{b_{13.24} \times b_{31.24}} = \sqrt{\cdot 260 \times -\cdot 198} = \underline{-\cdot 227}$$

$$r_{14.23} = \sqrt{b_{14.23} \times b_{41.23}} = \sqrt{\cdot 188 \times \cdot 185} = \underline{\cdot 187}$$

$$r_{23.14} = \sqrt{b_{23.14} \times b_{32.14}} = \sqrt{\cdot 567 \times \cdot 338} = \underline{\cdot 469}$$

$$r_{24.13} = \sqrt{b_{24.13} \times b_{42.13}} = \sqrt{\cdot 280 \times \cdot 217} = \underline{\cdot 246}$$

$$r_{34.12} = \sqrt{b_{34.12} \times b_{43.12}} = \sqrt{\cdot 416 \times \cdot 540} = \underline{\cdot 472}$$

Partial Correlation Coefficients of Intelligence, Engineering Ability, Spatial Perception and Accuracy of Movement.

GROUP 2.

Corr. Coefft. of Intelligence and Mng. Ability = r_{12} = 0.370

" " " " " Spat. Percept. = r_{13} = 0.655

" " " " " Accy. of Move. = r_{14} = 0.346

" " " Mng. Ability and Spat. Percept. = r_{23} = 0.630

" " " " " Accy. of Move. = r_{24} = 0.445

" " " Spat. Percept. & Accy. of Move. = r_{34} = 0.680

$$\Delta = \begin{vmatrix} r_{11} & r_{12} & r_{13} & r_{14} \\ r_{21} & r_{22} & r_{23} & r_{24} \\ r_{31} & r_{32} & r_{33} & r_{34} \\ r_{41} & r_{42} & r_{43} & r_{44} \end{vmatrix}$$

$$\Delta = \begin{vmatrix} 1.00 & .370 & .655 & .346 \\ .370 & 1.00 & .630 & .445 \\ .655 & .630 & 1.00 & .680 \\ .346 & .445 & .680 & 1.00 \end{vmatrix}$$

$$\Delta_{11} = \begin{vmatrix} 1.00 & .630 & .445 \\ .6031 & -.0166 & \\ .630 & 1.00 & .680 \\ -.0166 & .5376 & \\ .445 & .680 & 1.00 \end{vmatrix} = .32393$$

Partial Correlation Coefficients. GROUP 2. (Continued).

$$\Delta_{22} = \begin{vmatrix} 1.00 & .655 & .346 \\ .5710 & .0994 & \\ .655 & 1.00 & .680 \\ .0994 & .5376 & \\ .346 & .680 & 1.00 \end{vmatrix} = .29709$$

$$\Delta_{33} = \begin{vmatrix} 1.00 & .370 & .346 \\ .8631 & -.18135 & \\ .370 & 1.00 & .445 \\ -.18135 & .802 & \\ .346 & .445 & 1.00 \end{vmatrix} = .65932$$

$$\Delta_{44} = \begin{vmatrix} 1.00 & .370 & .655 \\ .8631 & -.4219 & \\ .370 & 1.00 & .630 \\ -.4219 & .6031 & \\ .655 & .630 & 1.00 \end{vmatrix} = .40262$$

$$\Delta_{12} = \begin{vmatrix} .370 & .630 & .445 \\ -.04265 & -.0166 & \\ .655 & 1.00 & .680 \\ .0994 & .5376 & \\ .346 & .680 & 1.00 \end{vmatrix} = -.02128$$

$$\Delta_{13} = \begin{vmatrix} .370 & 1.00 & .445 \\ -.4219 & .3997 & \\ .655 & .630 & .680 \\ .07350 & .3274 & \\ .346 & .445 & 1.00 \end{vmatrix} = \frac{-.1675}{.630} = -.2659$$

Partial Correlation Coefficients. GROUP 2. (Continued).

$$\Delta_{14} = \begin{vmatrix} .370 & 1.00 & .630 \\ & -.4219 & .6031 \\ .655 & .630 & 1.00 \\ & .07350 & -.0166 \\ .346 & .445 & .680 \end{vmatrix} = \frac{-.037321}{.630} = \underline{\underline{-.05924}}$$

$$\Delta_{23} = \begin{vmatrix} 1.00 & .370 & .346 \\ & .38765 & .03362 \\ .655 & .630 & .680 \\ & .07350 & .3274 \\ .346 & .445 & 1.00 \end{vmatrix} = \frac{.12444}{.630} = \underline{\underline{.1975}}$$

$$\Delta_{24} = \begin{vmatrix} 1.00 & .370 & .655 \\ & .38765 & -.04265 \\ .655 & .630 & 1.00 \\ & .07350 & -.0166 \\ .346 & .445 & .680 \end{vmatrix} = \frac{-.003300}{.630} = \underline{\underline{-.00524}}$$

$$\Delta_{34} = \begin{vmatrix} 1.00 & .370 & .655 \\ & .8631 & -.4219 \\ .370 & 1.00 & .630 \\ & -.18135 & .39965 \\ .346 & .445 & .680 \end{vmatrix} = \underline{\underline{.268426}}$$

Partial Correlation Coefficients. GROUP 2. (Continued).

$$b_{12.34} = \frac{\Delta_{12}}{\Delta_{11}} = \frac{-.02128}{.3439} = -.06567 \text{ say } -.066$$

$$b_{13.24} = \frac{\Delta_{13}}{\Delta_{11}} = \frac{-.2659}{.3439} = -.82056 \text{ say } -.821$$

$$b_{14.23} = \frac{\Delta_{14}}{\Delta_{11}} = \frac{-.05924}{.3439} = -.18281 \text{ say } -.183$$

$$b_{21.34} = \frac{\Delta_{12}}{\Delta_{22}} = \frac{-.02128}{.2971} = -.07163 \text{ say } -.072$$

$$b_{23.14} = \frac{\Delta_{23}}{\Delta_{22}} = \frac{.1975}{.2971} = .6715 \text{ say } .672$$

$$b_{24.13} = \frac{\Delta_{24}}{\Delta_{22}} = \frac{-.00524}{.2971} = -.01764 \text{ say } -.018$$

$$b_{31.24} = \frac{\Delta_{13}}{\Delta_{33}} = \frac{-.2659}{.6593} = -.4063 \text{ say } -.406$$

$$b_{32.14} = \frac{\Delta_{23}}{\Delta_{33}} = \frac{.1975}{.6593} = .2996 \text{ say } .30$$

$$b_{34.12} = \frac{\Delta_{34}}{\Delta_{33}} = \frac{.2684}{.6593} = .4015 \text{ say } .402$$

$$b_{41.23} = \frac{\Delta_{14}}{\Delta_{44}} = \frac{-.05924}{.6593} = -.1471 \text{ say } -.147$$

$$b_{42.13} = \frac{\Delta_{24}}{\Delta_{44}} = \frac{-.00524}{.6593} = -.01301 \text{ say } -.013$$

$$b_{43.12} = \frac{\Delta_{34}}{\Delta_{44}} = \frac{.2684}{.6593} = .6666 \text{ say } .667$$

Partial Correlation Coefficients. GROUP 2. (Continued).

The Regression Equations are :-

$$\bar{x}_1 = b_{12.34} x_2 + b_{13.24} x_3 + b_{14.23} x_4$$

$$= \underline{\underline{-\cdot066\, x_2 \; -\cdot821\, x_3 \; -\cdot183\, x_4}}$$

$$\bar{x}_2 = b_{21.34} x_1 + b_{23.14} x_3 + b_{24.13} x_4$$

$$= \underline{\underline{-\cdot072\, x_1 + \cdot672\, x_3 - \cdot018\, x_4}}$$

$$\bar{x}_3 = b_{31.24} x_1 + b_{32.14} x_2 + b_{34.12} x_4$$

$$= \underline{\underline{-\cdot406\, x_1 + \cdot30\, x_2 + \cdot402\, x_4}}$$

$$\bar{x}_4 = b_{41.23} x_1 + b_{42.13} x_2 + b_{43.12} x_4$$

$$= \underline{\underline{-\cdot147\, x_1 \; -\cdot013\, x_2 + \cdot667\, x_4}}$$

The Partial Correlation Coefficients then are :-

$$r_{12.34} = \sqrt{b_{12.34} \times b_{21.34}} = \sqrt{-\cdot066 \times -\cdot072} = \underline{\underline{-\cdot0689}}$$

$$r_{13.24} = \sqrt{b_{13.24} \times b_{31.24}} = \sqrt{-\cdot321 \times -\cdot406} = \underline{\underline{-\cdot377}}$$

$$r_{14.23} = \sqrt{b_{14.23} \times b_{41.23}} = \sqrt{-\cdot183 \times -\cdot147} = \underline{\underline{-\cdot164}}$$

$$r_{23.14} = \sqrt{b_{23.14} \times b_{32.14}} = \sqrt{\cdot672 \times \cdot30} = \underline{\underline{\cdot449}}$$

$$r_{24.13} = \sqrt{b_{24.13} \times b_{42.13}} = \sqrt{-\cdot018 \times -\cdot013} = \underline{\underline{-\cdot015}}$$

$$r_{34.12} = \sqrt{b_{34.12} \; b_{43.12}} = \sqrt{\cdot402 \times \cdot667} = \underline{\underline{\cdot516}}$$

Partial Correlation Coefficients of Intelligence, Engineering Ability, Spatial Perception And Accuracy of Movement .

GROUPS 1 and 2 together .

Corr. Coefft. of Intelligence and Eng. Ability = r_{12} = 0.419

" " " " " Spat. Percept. = r_{13} = 0.630

" " " " " Accy. of Move. = r_{14} = 0.40

" " " Eng. Ability " Spat. Percept. = r_{23} = 0.593

" " " " " " Accy. of Move. = r_{24} = 0.333

" " " Spat. Percept. " Accy of Move. = r_{34} = 0.633

$$\Delta = \begin{vmatrix} r_{11} & r_{12} & r_{13} & r_{14} \\ r_{21} & r_{22} & r_{23} & r_{24} \\ r_{31} & r_{32} & r_{33} & r_{34} \\ r_{41} & r_{42} & r_{43} & r_{44} \end{vmatrix}$$

$$\Delta = \begin{vmatrix} 1.00 & .419 & .630 & .40 \\ .419 & 1.00 & .593 & .333 \\ .630 & .593 & 1.00 & .633 \\ .40 & .333 & .633 & 1.00 \end{vmatrix}$$

Partial Correlation Coefficients. GROUPS 1.and 2. (Continued)

$$\Delta_{11} = \begin{vmatrix} 1.00 & .593 & .333 \\ .6484 & .0424 & \\ .593 & 1.00 & .633 \\ .0424 & .5993 & \\ .333 & .633 & 1.00 \end{vmatrix} = .3868$$

$$\Delta_{22} = \begin{vmatrix} 1.00 & .63 & .40 \\ .6031 & -.0012 & \\ .63 & 1.00 & .633 \\ -.0012 & .5993 & \\ .40 & .633 & 1.00 \end{vmatrix} = .3614$$

$$\Delta_{33} = \begin{vmatrix} 1.00 & .419 & .40 \\ .8244 & -.2605 & \\ .419 & 1.00 & .333 \\ -.2605 & .8891 & \\ .40 & .333 & 1.00 \end{vmatrix} = .6651$$

$$\Delta_{44} = \begin{vmatrix} 1.00 & .419 & .63 \\ .8244 & -.3815 & \\ .419 & 1.00 & .593 \\ -.3815 & .6484 & \\ .63 & .593 & 1.00 \end{vmatrix} = .3892$$

$$\Delta_{12} = \begin{vmatrix} .419 & .593 & .333 \\ .0454 & .0424 & \\ .63 & 1.00 & .633 \\ -.0012 & .5993 & \\ .40 & .633 & 1.00 \end{vmatrix} = .0277$$

Partial Correlation Coefficients. GROUPS 1 and 2. (Continued).

$$\Delta_{13} = \begin{vmatrix} .419 & 1.00 & .533 \\ -.3815 & & .4355 \\ .63 & .593 & .533 \\ -.0274 & & .3822 \\ .40 & .333 & 1.00 \end{vmatrix} = \frac{-.1339}{.593} = \underline{-.2258}$$

$$\Delta_{14} = \begin{vmatrix} .419 & 1.00 & .593 \\ -.3815 & & .6484 \\ .63 & .593 & 1.00 \\ -.0274 & & .0424 \\ .40 & .333 & .633 \end{vmatrix} = \frac{.0016}{.593} = \underline{.0027}$$

$$\Delta_{23} = \begin{vmatrix} 1.00 & .419 & .40 \\ .3290 & & .0280 \\ .63 & .593 & .633 \\ -.0274 & & .3822 \\ .40 & .333 & 1.00 \end{vmatrix} = \frac{.12651}{.593} = \underline{.2134}$$

$$\Delta_{24} = \begin{vmatrix} 1.00 & .419 & .63 \\ .3290 & & .0354 \\ .63 & .593 & 1.00 \\ .0274 & & .0424 \\ .40 & .333 & .633 \end{vmatrix} = \frac{.01299}{.593} = \underline{.0222}$$

$$\Delta_{34} = \begin{vmatrix} 1.00 & .419 & .63 \\ .8244 & & -.3815 \\ .419 & 1.00 & .593 \\ -.2605 & & .4355 \\ .40 & .333 & .633 \end{vmatrix} = \underline{.2596}$$

Partial Correlation Coefficients. GROUPS 1.and2. (Continued).

$b_{12.34} = \frac{\Delta_{12}}{\Delta_{11}} = \frac{.0277}{.3868} = .07161$ say .072

$b_{13.24} = \frac{\Delta_{13}}{\Delta_{11}} = \frac{-.2258}{.3868} = -.58376$ say -.584

$b_{14.23} = \frac{\Delta_{14}}{\Delta_{11}} = \frac{.0027}{.3868} = .00698$ say .007

$b_{21.34} = \frac{\Delta_{12}}{\Delta_{22}} = \frac{.0277}{.3614} = .076646$ say .0766

$b_{23.14} = \frac{\Delta_{23}}{\Delta_{22}} = \frac{.2134}{.3614} = .59048$ say .590

$b_{24.13} = \frac{\Delta_{24}}{\Delta_{22}} = \frac{.0222}{.3614} = .06143$ say .061

$b_{31.24} = \frac{\Delta_{13}}{\Delta_{33}} = \frac{-.2258}{.6651} = -.33949$ say -.339

$b_{32.14} = \frac{\Delta_{23}}{\Delta_{33}} = \frac{.2134}{.6651} = .32085$ say .321

$b_{34.12} = \frac{\Delta_{34}}{\Delta_{33}} = \frac{.2596}{.6651} = .39031$ say .390

$b_{41.23} = \frac{\Delta_{14}}{\Delta_{44}} = \frac{.0027}{.3892} = .00693$ say .007

$b_{42.13} = \frac{\Delta_{24}}{\Delta_{44}} = \frac{.0222}{.3892} = .05704$ say .057

$b_{43.12} = \frac{\Delta_{34}}{\Delta_{44}} = \frac{.2596}{.3892} = .66701$ say .667

Partial Correlation Coefficients. GROUPS 1. and 2. (Continued)

The Regression Equations are:-

$$\bar{x}_1 = b_{12.34} x_2 + b_{13.24} x_3 + b_{14.23} x_4$$
$$= .072 x_2 - .584 x_3 + .007 x_4$$

$$\bar{x}_2 = b_{21.34} x_1 + b_{23.14} x_3 + b_{24.13} x_4$$
$$= .0766 x_1 + .590 x_3 + .061 x_4$$

$$\bar{x}_3 = b_{31.24} x_1 + b_{32.14} x_2 + b_{34.12} x_4$$
$$= -.339 x_1 + .321 x_2 + .390 x_4$$

$$\bar{x}_4 = b_{41.23} x_1 + b_{42.13} x_2 + b_{43.12} x_3$$
$$= .007 x_1 + .057 x2 + .667 x_3$$

The Partial Correlation Coefficients then are :-

$$r_{12.34} = \sqrt{b_{12.34} \times b_{21.34}} = \sqrt{.072 \times .077} = .075$$

$$r_{13.24} = \sqrt{b_{13.24} \times b_{31.24}} = \sqrt{-.584 \times -.339} = -.445$$

$$r_{14.23} = \sqrt{b_{14.23} \times b_{41.23}} = \sqrt{.007 \times .007} = .007$$

$$r_{23.14} = \sqrt{b_{23.14} \times b_{32.14}} = \sqrt{.590 \times .321} = .435$$

$$r_{24.13} = \sqrt{b_{24.13} \times b_{42.13}} = \sqrt{.061 \times .057} = .059$$

$$r_{34.12} = \sqrt{b_{34.12} \times b_{43.12}} = \sqrt{.390 \times .667} = .510$$

Partial Correlation Coefficients of Intelligence, Spatial Perception and Accuracy of Movement, GROUP 3.

Let Intelligence = x
Spat. Percep. = y
Accy. of Move. = z

Then the partial correlation coefficient of say x on z is the geometric mean of the coefficient to z in the regression equation of x on z and z on y, and that of x in the regression of z on x and y.

Part. Corr. Coefft. of x on z

$$= \sqrt{\frac{\sigma_z(r_{xz} - r_{xy} \times r_{yz})\,\sigma_x(r_{xz} - r_{xy} \times r_{yz})}{\sigma_x(1 - r_{xy}^2)(1 - r_{yz}^2)\sigma_z}}$$

$$= \frac{r_{xz} - r_{xy} \times r_{yz}}{\sqrt{(1 - r_{xy}^2)(1 - r_{yz}^2)}} = \frac{0.014 - .320 \;\; .246}{\sqrt{\left[1 - (.320)^2\right]\left[1 - (.246)^2\right]}}$$

$$= \frac{0.014 - 0.0786}{\sqrt{(1 - 0.1024)(1 - 0.0652)}} = \frac{-0.0646}{\sqrt{0.8976 \times 0.9348}}$$

$$= \frac{-0.0646}{0.916} = \underline{\underline{-0.0706}}$$

Part. Corr. Coefft. of y on z $= \dfrac{r_{yz} - r_{yx} \times r_{xz}}{\sqrt{(1 - r_{yx}^2)(1 - r_{xz}^2)}}$

$$\frac{0.246 - (0.320 \times 0.014)}{\sqrt{\left[1 - (.320)^2\right]\left[1 - (.013)^2\right]}} = \frac{0.246 - 0.00448}{\sqrt{0.8976 \times 0.999}} = \frac{.2145}{.947} = \underline{\underline{0.254}}$$

Part. Corr Coefft. of x on y $= \dfrac{r_{xy} - r_{xz} \times r_{zy}}{\sqrt{(1 - r_{xz}^2)(1 - r_{zy}^2)}}$

$$\frac{0.320 - (0.014 \times 0.246)}{\sqrt{\left[1 - (.014)^2\right]\left[1 - (.246)^2\right]}} = \frac{0.320 - .00344}{\sqrt{0.999 \times 0.935}} = \frac{0.317}{0.966} = \underline{\underline{0.328}}$$

Partial Correlation Coefficients of Intelligence, Spatial Perception and Accuracy of Movement. (For all Subjects.)

Let Intelligence = x

Spat. Percept. = y

Accy. of Move. = z

Then Partial Correlation Coefficient of x on z

$$= \frac{r_{xz} - r_{xy} \times r_{yz}}{\sqrt{\left[1 - r_{xy}^2\right]\left[1 - r_{yz}^2\right]}} = \frac{0.294 - 0.518 \times 0.521}{\sqrt{\left[1 - (.518)^2\right]\left[1 - (.521)^2\right]}}$$

$$= \frac{0.294 - 0.270}{\sqrt{(1 - 0.2683)(1 - 0.2714)}} = \frac{0.024}{\sqrt{0.7317 \times 0.7286}}$$

$$= \frac{0.024}{0.730} = \underline{0.0328}$$

Partial Correlation Coefficient of y on z

$$= \frac{r_{yz} - r_{yx} \times r_{xz}}{\sqrt{\left[1 - r_{yx}^2\right]\left[1 - r_{xz}^2\right]}} = \frac{0.521 - 0.518 \times 0.294}{\sqrt{\left[1 - (.518)^2\right]\left[1 - (.294)^2\right]}}$$

$$= \frac{0.521 - 0.1495}{\sqrt{(1 - 0.2683)(1 - 0.0864)}} = \frac{0.3715}{\sqrt{0.7317 \times 0.9136}}$$

$$= \frac{0.3715}{0.817} = \underline{0.455}$$

Partial Correlation Coefficient of x on y

$$= \frac{r_{xy} - r_{xz} \times r_{yz}}{\sqrt{\left[1 - r_{xz}^2\right]\left[1 - r_{yz}^2\right]}} = \frac{0.518 - 0.294 \times 0.521}{\sqrt{\left[1 - (.294)^2\right]\left[1 - (.521)^2\right]}}$$

$$= \frac{0.518 - 0.153}{\sqrt{(1 - 0.0864)(1 - 0.2714)}} = \frac{0.365}{\sqrt{0.9136 \times 0.7286}}$$

$$= \frac{0.365}{0.815} = \underline{0.448}$$

The Partial Correlation Coefficients found are here collected and can be compared in the various groups.

	Group 1.	Group 2.	Groups 1 and 2. (together)
$r_{12.34}$ =	.324	−.0689	.075
$r_{13.24}$ =	−.227	−.577	−.445
$r_{14.23}$ =	.187	−.164	.007
$r_{23.14}$ =	.469	.449	.435
$r_{24.13}$ =	.246	−.015	.059
$r_{34.12}$ =	.472	.516	.510

	Group 3.	Groups 1, 2, and 3. (together)
r of x on z =	−.0706	.0328
r of y on z =	.254	.455
r of x on y =	.328	.448

For Groups 1. and 2., and 1. and 2. together :-

Intelligence is denoted by the suffix 1

Engineering Ability " " " " " 2

Spatial Perception " " " " " 3

Accuracy of Movement " " " " " 4

Then $r_{12.34}$ means the correlation of 1 and 2 , 3 and 4 being constant.

Similarly for $r_{13.24}$, $r_{14.23}$, etc.

The large negative correlation in $r_{13.24}$ is difficult to explain. On the whole however the Partial Correlation Coefficients are consistent. It may be that in groups of about 30 only, accidental errors may have proved rather large. Also the theory of partial correlation coefficients is applicable only when certain assumptions re Normal Distribution etc. are made, and it is possible that within the limits of this investigation these

assumptions may not be wholly justified.

Applying the Regression Equation for Group consisting of Groups 1. and 2. together as found on page 76, to Group 3. to determine the probable average for this group in Engineering Ability, since the subjects in this group did not perform the tests for Engineering Ability, we have :-

Regression Equation :-

$$\bar{x}_2 = b_{21.34}\, x_1 + b_{23.14}\, x_3 + b_{24.13}\, x_4$$

$$= .0766\, x_1 + .590\, x_2 + .061\, x_4$$

x = (X – Mean)

Hence

$$(\bar{X}_2 - 6.41) = .0766\,(X_1 - 59.6) + .590\,(X_3 - 6.94) + .061\,(X_4 - 14.2)$$

$$= .0766(64.55 - 59.6) + .590\,(6.8 - 6.94) + .061\,(13.5 - 14.2)$$

$$= (.0766 \times 4.95) + (.590 \times -.14) + (.061 \times -.7)$$

$$= .379 + (-.0826) + (-.0427)$$

$$\bar{X}_2 = 6.41 + .379 - .0826 - .0427$$

$$= 6.6637$$

$$= \text{say } 6.66$$

So that the average for Engineering Ability for Group 3. would be 6.66.

The authDr then corellated Engineering Ability and the whole Battery of tests for the group of subjects (57 in all) made up by combining Groups 1.and 2. together; the correlation is shown on the following pages 81 -83.

APPENDIX.

Note :- This Appendix contains all the worked out correlations which are tabulated on pages 57 - 60, in the order in which they come in the tables.

The coefficients of correlation are worked out by the Bravais-Pearson method ; x and y are the deviations of each of the measures from the mean value of its series. The nearest whole number to the mean is generally taken as a provisional mean and the balance is restored afterwards be a suitable correction.

Correlation of Eng. Ability and Battery of Tests. Groups 1 & 2 together.

(57 subjects in all)

Subject	Eng. Ability	Battery of Tests	x	y	x^2	y^2	xy
"I"	8.5	29.6	2.5	1.6	6.3	2.6	4.0
"II"	6.4	31.5	0.4	3.5	0.2	12.3	1.4
"III"	2.4	21.9	-2.6	-6.1	13.0	37.2	22.0
"IV"	5.4	28.5	-0.6	0.5	etc.	0.3	-0.3
"V"	6.5	31.3	0.5	3.3	Σx^2 =	10.9	1.7
"VI"	8.0	41.8	2.0	13.8	153.3	190.4	27.6
"VII"	8.6	34.7	2.6	6.7	corrected	44.9	17.4
"VIII"	5.9	29.8	-0.1	1.8	144.2	3.2	-0.2
"IX"	5.5	20.8	-0.5	-7.2		51.8	3.6
"X"	8.7	40.5	2.7	12.5		156.3	33.7
"XI"	7.0	29.4	1.0	1.4		2.0	1.4
"XII"	2.3	22.7	-3.7	-5.3		28.1	19.6
"XIII"	7.4	29.6	1.4	1.6		2.6	2.2
"XIV"	8.4	33.9	2.4	5.9		34.8	14.2
"XV"	5.0	24.9	-1.0	-3.1		9.6	3.1
"XVI"	7.8	33.0	1.8	5.0		25.0	9.0
"XVII"	6.9	28.3	0.9	0.3		0.1	0.3
"XVIII"	7.9	32.3	1.9	4.3		18.5	8.2
"XIX"	7.6	26.3	1.6	-1.7		2.9	-2.7
"XX"	8.3	26.9	2.3	-1.1		1.2	-2.5
"XXI"	8.9	36.7	2.9	8.7		75.7	25.2
"XXII"	6.7	22.5	0.7	-5.5		30.3	-3.8
"XXIII"	7.6	27.5	1.6	-0.5		0.3	-0.8
"XXIV"	6.7	26.6	0.7	-1.4		2.0	-1.0
"XXV"	6.8	23.9	0.8	-4.1		16.8	-3.3
"XXVI"	6.4	25.1	0.4	-2.9		8.4	-1.2
"XXVII"	6.7	37.7	0.7	9.7		94.1	6.8
"A"	5.0	18.2	-1.0	-9.8		96.0	9.8
"B"	7.0	20.5	1.0	-7.5		56.3	-7.5
"C"	7.5	21.6	1.5	-6.4		41.0	-9.6

Correlation of Eng. Ability and Battery of Tests.

Group 1.

subject	Eng. Ability	Battery of Tests	x	y	x^2	y^2	xy
"A"	5.0	18.2	-1.0	-9.8	1.0	96.0	9.8
"B"	7.0	20.5	1.0	-7.5	1.0	56.3	-7.5
"C"	7.5	21.6	1.5	-6.4	2.3	41.0	-9.6
"D"	5.0	15.9	-1.0	-12.1	etc.	146.4	12.1
"E"	4.5	23.5	-1.5	-4.5		20.3	6.8
"F"	4.9	24.3	-1.1	-3.7		13.7	4.1
"G"	5.8	26.5	-0.2	-1.5		2.3	0.3
"H"	4.9	25.1	-1.1	-2.9		8.4	3.2
"I"	6.8	27.8	0.8	-0.2		0	-0.2
"J"	5.5	20.0	-0.5	-8.0		64.0,	4.0
"K"	4.5	23.9	-1.5	-4.1		16.8	6.2
"L"	4.8	31.1	-1.2	3.1		9.6	-3.7
"M"	4.0	21.1	-2.0	-6.9		47.6	13.8
"N"	4.2	20.5	-1.8	-7.5		56.3	13.5
"O"	9.0	25.6	3.0	-2.4		5.8	-7.2
"P"	7.0	29.8	1.0	1.8		3.2	1.8
"Q"	7.1	23.8	1.1	-4.2		17.6	-4.6
"R"	6.1	24.4	0.1	-3.6		13.0	-0.4
"S"	8.5	45.7	2.5	17.7		313.3	44.2
"T"	5.3	21.4	-0.7	-6.6		43.6	4.6
"U"	8.6	16.6	2.6	-11.4		130.0	-29.6
"V"	5.3	23.5	-0.7	-4.5		20.3	3.2
"W"	5.1	31.9	-0.9	3.9		15.2	-3.5
"X"	5.4	23.4	-0.6	-4.6		21.2	2.8
"Y"	5.7	25.5	-0.3	-2.5		6.3	0.8
"Z"	7.2	21.3	1.2	-6.7		44.9	-8.0
"a"	6.8	31.3	0.8	3.3		10.9	2.6
"b"	4.0	19.2	-2.0	-8.8		77.4	17.6
"c"	7.8	28.2	1.8	0.2		0	0.4
"d"	8.2	30.8	2.2	2.8		7.8	6.2

Correlation of Eng. Ability and Battery of Tests. Groups 1 & 2 together. (Cont.)

(57 subjects in all)

Subject	Eng. Ability	Battery of Tests	x	y	x^2	y^2	xy
"D"	5.0	15.9	-1.0	-12.1		146.4	12.1
"E"	4.5	23.5	-1.5	-4.5		20.3	6.8
"F"	4.9	24.3	-1.1	-3.7		13.7	4.1
"G"	5.8	26.5	-0.2	-1.5		2.3	0.3
"H"	4.9	25.1	-1.1	-2.9		8.4	3.2
"I"	6.8	27.8	0.8	-0.2		0	-0.2
"J"	5.5	20.0	-0.5	-8.0		64.0	4.0
"K"	4.5	23.9	-1.5	-4.1		16.8	6.2
"L"	4.8	31.1	-1.2	3.1		9.6	-3.7
"M"	4.0	21.1	-2.0	-6.9		47.6	13.8
"N"	4.2	20.5	-1.8	-7.5		56.3	13.5
"O"	9.0	25.6	3.0	-2.4		5.8	-7.2
"P"	7.0	29.8	1.0	1.8		3.2	1.8
"Q"	7.1	23.8	1.1	-4.2		17.6	-4.6
"R"	6.1	24.4	0.1	-3.6		13.0	-0.4
"S"	8.5	45.7	2.5	17.7		313.3	44.2
"T"	5.3	21.4	-0.7	-6.6		43.6	4.6
"U"	8.6	16.6	2.6	-11.4		130.0	-29.6
"V"	5.3	23.5	-0.7	-4.5		20.3	3.2
"W"	5.1	31.9	-0.9	3.9		15.2	-3.5
"X"	5.4	23.4	-0.6	-4.6		21.2	2.8
"Y"	5.7	25.5	-0.3	-2.5		6.3	0.8
"Z"	7.2	21.3	1.2	-6.7		44.9	-8.0
"a"	6.8	31.3	0.8	3.3		10.9	2.6
"b"	4.0	19.2	-2.0	-8.8		77.4	17.6
"c"	7.8	28.2	1.8	0.2		0	0.4
"d"	8.2	30.8	2.2	2.8		7.8	6.2
	average	average				Σy^2 =	Σxy =
	6.41	27.7				2171.5	269.3
	prov.mean	prov.mean				corrected	corrected
	6.0	28.0				2166.4	276.1

Correlation Coefficient of Engineering Ability and Battery of Tests. Gropp 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{103.3}{\sqrt{55.6 \times 1557.2}}$$

$$= \underline{0.352}$$

$$\text{Standard error of } r = \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.352)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.124}{5.47}$$

$$= \frac{0.876}{5.47}$$

$$= \underline{0.16}$$

$$\text{Probable error of } r = 0.674 \times 0.16$$

$$= \underline{0.1081}$$

Correlation Coefficient of Eng. Ability and Battery of Tests.

Groups 1 & 2 together. (57 subjects in all)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma y^2 \times \Sigma x^2}} = \frac{276.1}{2166.4 \times 144.2}$$

$$= \frac{276.1}{46.54 \times 12.0}$$

$$= \underline{.0.495}$$

Standard error of r $$= \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.495)^2}{\sqrt{57}}$$

$$= \frac{1 - 0.245}{7.55}$$

$$= \frac{0.755}{7.55}$$

$$= \underline{0.100}$$

Probable error of r $$= 0.674 \times 0.100$$

$$= \underline{0.0674}$$

Correlation of Eng. Ability and Battery of Tests.

Group 2.

Subject	Eng. Ability	Battery of Tests	x	y	x^2	y^2	xy
"I"	8.5	29.6	2.5	1.6	6.3	2.6	4.0
"II"	6.4	31.5	0.4	3.5	0.2	12.3	1.4
"III"	2.4	21.9	-3.6	-6.1	13.0	37.2	22.0
"IV"	5.4	28.5	-0.6	0.5	etc.	0.3	-0.3
"V"	6.5	31.3	0.5	3.3		10.9	1.7
"VI"	8.0	41.8	2.0	13.8		190.4	27.6
"VII"	8.6	34.7	2.6	6.7		44.9	17.4
"VIII"	5.9	29.8	-0.1	1.8		3.2	-0.2
"IX"	5.5	20.8	-0.5	-7.2		51.8	3.6
"X"	8.7	40.5	2.7	12.5		156.3	33.7
"XI"	7.0	29.4	1.0	1.4		2.0	1.4
"XII"	2.3	22.7	-3.7	-5.3		28.1	19.6
"XIII"	7.4	29.6	1.4	1.6		2.6	2.2
"XIV"	8.4	33.9	2.4	5.9		34.8	14.2
"XV"	5.0	24.9	-1.0	-3.1		9.6	3.1
"XVI"	7.8	33.0	1.8	5.0		25.0	9.0
"XVII"	6.9	28.3	0.9	0.3		0.1	0.3
"XVIII"	7.9	32.3	1.9	4.3		18.5	8.2
"XIX"	7.6	26.3	1.6	-1.7		2.9	-2.7
"XX"	8.3	26.9	2.3	-1.1		1.2	-2.5
"XXI"	8.9	36.7	2.9	8.7		75.7	25.2
"XXII"	6.7	22.5	0.7	-5.5		30.3	-3.8
"XXIII"	7.6	27.5	1.6	-0.5		0.3	-0.8
"XXIV"	6.7	26.6	0.7	-1.4		2.0	-1.0
"XXV"	5.8	23.9	0.8	-4.1		16.8	-3.3
"XXVI"	6.4	25.1	0.4	-2.9		8.4	-1.2
"XXVII"	6.7	37.7	0.7	9.7		94.1	6.8

Correlation Coefficient of Engineering Ability and Battery of Tests. Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{153.2}{\sqrt{74.0 \times 790.5}}$$

$$= \frac{153.2}{8.60 \times 28.1}$$

$$= \underline{\underline{0.633}}$$

$$\text{Standard Error of } r = \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.633)^2}{\sqrt{27}}$$

$$= \frac{0.603}{5.19}$$

$$= \underline{\underline{0.116}}$$

$$\text{Probable error of } r = 0.674 \times 0.116$$

$$= \underline{\underline{0.078}}$$

Correlation of Intelligence and Spatial Perception (Cubebuilding)

GROUP 1.

Subject	Intelligence	Spatial Percept.	x	y	x^2	y^2	xy
"A"	45.2	1.7	-6.8	-4.3	46.2	18.4	29.2
"B"	39.5	3.3	-12.5	-2.7	156.0	7.3	33.8
"C"	65.1	8.4	13.1	2.4	171.5	5.8	31.4
"D"	26.7	4.4	-25.3	-1.6	640.0	2.6	40.5
"E"	54.2	7.0	2.2	1.0	4.8	1.0	2.2
"F"	47.0	2.3	-5.0	-3.7	25.0	13.6	18.5
"G"	40.3	6.8	-11.7	0.8	137.0	0.6	-9.35
"H"	66.1	5.0	14.1	-1.0	198.1	1.0	-14.1
"I"	49.2	8.5	-2.8	2.5	7.8	6.3	-7.0
"J"	54.0	3.2	2.0	-2.8	4.0	7.8	-5.6
"K"	55.2	7.7	3.2	1.7	10.2	2.9	5.4
"L"	44.0	8.7	-8.0	2.7	64.0	7.3	-21.6
"M"	53.1	2.8	1.1	-3.2	1.2	10.2	-3.5
"N"	51.2	3.0	-0.8	-3.0	0.6	9.0	2.4
"O"	73.5	6.4	21.5	0.4	461.0	0.2	8.6
"P"	46.8	12.3	5.2	6.3	27.1	39.6	32.8
"Q"	53.0	9.0	1.0	3.0	1.0	9.0	3.0
"R"	66,8	6.3	14.8	0.3	219.0	0.1	4.4
"S"	89.0	18.9	37.0	12.9	1370.0	166.0	477.0
"T"	34.0	2.7	-18.0	-3.3	324.0	10.9	59.5
"U"	37.0	2.2	-14.0	-3.8	196.0	14.4	53.1
"V"	59.3	4.7	7.3	-1.3	53.2	1.7	-9.5
"W"	54.7	6.5	2.7	0.5	7.3	0.3	1.4
"X"	54.2	4.5	2.2	-1.5	4.8	2.3	-3.3
"Y"	54.2	5.2	2.2	-0.8	4.8	0.6	-1.8
"Z"	37.0	7.9	-15.0	1.9	225.0	3.6	-28.5
"a"	67.8	5.2	15.8	-0.8	249.0	0.6	-12.6
"b"	12.0	7.2	-40.0	1.2	1600.0	1.4	-48.0
"c"	56.2	5.9	4.2	-0.1	17.6	0	-0.4
"d"	64.5	14.5	12.5	8.5	156.0	72.0	106.0
					$\Sigma x^2 =$	$\Sigma y^2 =$	$\Sigma xy =$
	prov.mean	prov.mean			6379.6	411.7	746.6
	52.0	6.0					

Correlation Coefficient of Intelligence and Spatial Perception.

(Cubebuilding) (r). Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{747.6}{\sqrt{6379.6 \times 411.7}}$$

$$= \frac{747.6}{79.87 \times 20.29}$$

$$= \frac{746.6}{1620}$$

$$= \underline{0.46}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no of subjects.

$$= \frac{1 - (0.46)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.211}{5.48}$$

$$= \frac{0.789}{5.48}$$

$$= \underline{0.144}$$

Probable error of r $= 0.674 \times 0.144$

$$= \underline{0.097}$$

Correlation of Intelligence and Spatial Perception (Formboards)

GROUP 1.

Subject	Intell-igence.	Spatial Percept.	x	y	x^2	y^2	xy
"A"	45.2	1.8	-6.8	-2.2	46.2	4.8	15.0
"B"	39.5	2.7	-12.5	-1.3	156.0	1.7	16.3
"C"	65,1	4.7	13.1	0.7	171.5	0.5	9.2
"D"	etc.	1.9	-25.3	-2.1	etc.	4.4	53.1
"E"	average	2.6	2.2	-1.4	Σx^2 =	2.0	-3.1
"F"	51.69	4.4	-5.0	0.4	6382.3	0.2	-2.0
"G"	prov.mean	4.2	-11.7	0.2	Corrected	0.04	-2.3
"H"	52.0	4.4	14.1	0.4	6379.6	0.2	5.6
"I"		7.7	-2.8	3.7		13.5	-10.4
"J"		4.8	2.0	0.8		0.6	1.6
"K"		3.1	3.2	-0.9		0.8	-2.9
"L"		4.7	-8.0	0.7		0.5	-5.6
"M"		3.8	1.1	-0.2		0.04	-0.2
"N"		5.5	-0.8	1.5		2.2	-1.2
"O"		5.7	21.5	1.7		2.9	36.6
"P"		6.0	5.2	2.0		4.0	10.4
"Q"		3.8	1.0	-0.2		0.04	-0.2
"R"		3.7	14.8	-0.3		0.1	-4.4
"S"		6.6	37.0	2.6		6.8	96.1
"T"		5.0	-18.0	1.0		1.0	-18.0
"U"		2.5	-14.0	-1.5		2.3	21.0
"V"		2.9	7.3	-1.1		1.2	-8.0
"W"		3.4	2.7	-0.6		0.4	-1.6
"X"		5.8	2.2	1.8		3.2	4.0
"Y"		3.5	2.2	-0.5		0.3	-1.1
"Z"		2.5	-15.0	-1.5		2.3	22.5
"a"		7.9	15.8	3.9		15.2	61.6
"b"		4.3	-40.0	0.3		0.1	-12.0
"c"		3.9	4.2	-0.1		0.01	-0.4
"d"		7.3	12.5	3.3		10.9	41.2
		prov.mean 4.0				Σy^2=82.3	Σxy=320.8
					Corrected	77.5	324.4

Correlation Coefficient of Intelligence and Spatial Perception (Formboards) (r). Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{324.4}{\sqrt{6379.6 \quad 77.5}}$$

$$= \frac{324.4}{79.87 \times 8.81}$$

$$= \frac{324.4}{701}$$

$$= \underline{0.458}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.458)^2}{\sqrt{30.}}$$

$$= \frac{1 - 0.21}{5.48}$$

$$= \frac{0.79}{5.48}$$

$$= \underline{0.144}$$

Probable error of r $= 0.674 \times 0.144$

$$= \underline{0.097}$$

Correlation of Intelligence and Stripbuilding.

GROUP 1.

Subject	Intell-igence	Strip-building	x	y	x^2	y^2	xy
"A"	45.2	3.5	-6.8	-3.5	46.2	12.3	23.8
"B"	39.5	5.3	-12.5	-1.7	156.3	2.9	21.2
"C"	65.1	8.1	13.1	1.1	171.6	1.2	14.4
"D"	etc.	4.8	-25.3	-2.2	etc.	4.8	55.6
"E"	average	9.0	2.2	2.0	Σx^2 =	4.0	4.4
"F"	51.69	5.7	-5.0	-1.3	6384.5	1.7	6.5
"G"	prov.mean	10.1	-11.7	3.1	corrected	9.6	-36.2
"H"	52.0	7.0	14.1	0	6379.6	0	0
"I"		9.6	-2.8	2.6		6.8	-7.3
"J"		5.0	2.0	-2.0		4.0	-4.0
"K"		5.6	3.2	-1.4		2.0	-4.5
"L"		8.1	-8.0	1.1		1.2	-8.8
"M"		7.2	1.1	0.2		0	0.2
"N"		4.0	-0.8	-3.0		9.0	2.4
"O"		8.3	21.5	1.3		1.7	28.0
"P"		10.4	5.2	3.4		11.6	17.7
"Q"		8.2	1.0	1.2		1.4	1.2
"R"		7.7	14.8	0.7		0.5	10.4
"S"		12.8	37.0	5.8		33.6	214.2
"T"		5.1	-18.0	-1.9		3.6	34.2
"U"		4.5	-14.0	-2.5		6.3	35.0
"V"		4.9	7.3	-2.1		4.4	-15.3
"W"		9.2	2.7	2.2		4.8	5.9
"X"		5.2	2.2	-1.8		3.2	-3.9
"Y"		7.7	2.2	0.7		0.5	1.5
"Z"		7.0	-15.0	0		0	0
"a"		6.9	15.8	-0.1		0	-1.6
"b"		8.9	-40.0	1.9		3.6	-76.0
"c"		8.5	4.2	1.5		2.3	6.3
"d"		12.3	12.5	5.3		28.1	66.2
		average 7.35 prov.mean = 7.0				Σy^2 = 165.1 corrected 161.9	Σxy = 391.5 394.8

Correlation Coefficient of Intelligence and Stripbuilding (r)

Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{394.8}{\sqrt{6379.6 \times 161.9}}$$

$$= \frac{394.8}{79.87 \times 12.72}$$

$$= \underline{0.390}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no, of subjects.

$$= \frac{1 - (0.39)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.152}{5.48}$$

$$= \frac{0.848}{5.48}$$

$$= \underline{0.131}$$

Probable error of r $= 0.674 \times 0.131$

$$= \underline{0.092}$$

Correlation of Intelligence and Acc. of Movement (Blindfolded)

GROUP 1.

Subject	Intell-igence	Est. of Movement	x	y	x^2	y^2	xy
"A"	45.2	15.4	-6.8	-1.6	46.2	46.2	10.9
"B"	39.5	11.6	-12.5	-5.4	156.0	29.1	67.5
"C"	65.1	10.5	13.1	-6.5	171.5	42.2	-85.0
"D"	etc.	11.6	-25.3	-5.4	etc.	29.1	136.5
"E"	average	11.3	2.2	-5.7	Σx^2 =	32.5	-12.5
"F"	51.69	17.8	-5.0	0.8	6382.3	0.6	-4.0
"G"	prov.mean	18.7	-11.7	1.7	corrected	2.9	-19.9
"H"	52.0	18.1	14.1	1.1	6379.6	1.2	15.5
"I"		18.5	-2.8	1.5		2.3	-4.2
"J"		13.8	2.0	-3.2		10.2	-6.4
"K"		16.6	3.2	-0.4		0.2	-1.3
"L"		28.6	-8.0	11.6		134.0	-92.8
"M"		14.1	1.1	-2.9		8.4	-3.2
"N"		14.9	-0.8	-2.1		4.4	1.
"O"		12.8	21.5	-4.2		17.6	-90.2
"P"		20.0	5.2	3.0		9.0	15.6
"Q"		12.3	1.0	-4.7		22.1	-4.7
"R"		16.7	14.8	-0.3		0.1	-4.4
"S"		39.0	37.0	22.0		484.0	814.0
"T"		17.9	-18.0	0.9		0.8	-16.2
"U"		10.3	-14.0	-6.7		44.7	94.0
"V"		16.7	7.3	-0.3		0.1	-2.2
"W"		29.4	2.7	12.4		154.0	33.4
"X"		16.1	2.2	-0.9		0.8	-2.0
"Y"		18.5	2.2	1.5		2.3	3.3
"Z"		14.1	-15.0	-2.9		8.4	43.5
"a"		23.8	15.8	6.8		46.2	107.5
"b"		12.7	-40.0	-4.3		18.5	172.0
"c"		21.8	4.2	4.8		23.0	2002
"d"		14.7	12.5	-2.3		5.3	-28.8
		prov.mean 17.0				Σy^2 = 1133.9	Σxy = 1165.1

Correlation Coefficient of Intelligence and Acc. of Movement.

(Blindfolded) (r). Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{1165.1}{\sqrt{6375.6 \times 1133.9}}$$

$$= \frac{1165.1}{79.87 \times 33.7}$$

$$= \frac{1165.1}{2690}$$

$$= \underline{0.433}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.433)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.196}{5.48}$$

$$= \frac{0.804}{5.48}$$

$$= \underline{0.147}$$

Probable error of r $= 0.674 \times 0.147$

$$= \underline{0.098}$$

Correlation of Intelligence and Accuracy of Movement.

GROUP 1.

Subject	Intell-igence	Acc. of Movement	x	y	x^2	y^2	xy
"A"	45.2	7.4	-6.8	-2.6	46.2	6.8	17.7
"B"	39.5	13.5	-12.5	3.5	156.0	12.2	-43.7
"C"	65.1	5.4	13.1	-4.6	171.5	21.2	-60.2
"D"	etc.	7.3	-25.3	-2.7	etc.	7.3	68.4
"E"	average	12.6	2.2	2.6	Σx^2 =	6.8	5.7
"F"	51.69	13.1	-5.0	3.1	6382.3	9.6	-15.5
"G"	prov.mean	12.3	-11.7	2.3	correcte	5.3	-26.9
"H"	52.0	7.9	14.1	-2.1	6379.6	4.4	-29.6
"I"	.	10.0	-2.8	0	.	0	0
"J"	.	6.8	2.0	-3.2	.	10.2	-6.4
"K"	.	9.1	3.2	-0.9	.	0.8	-2.9
"L"	.	10.4	-8.0	0.4	.	0.2	-3.2
"M"	.	8.3	1.1	-1.7	.	2.9	-1.9
"N"	.	7.5	-0.8	-2.5	.	6.3	2.0
"O"	.	9.9	21.5	-0.1	.	0.01	-2.2
"P"	.	10.9	5.2	0.9	.	0.8	4.7
"Q"	.	10.7	1.0	0.7	.	0.5	0.7
"R"	.	6.5	14.8	-3.5	.	12.2	-51.7
"S"	.	9.1	37.0	-0.9	.	0.8	-33.3
"T"	.	9.5	-18.0	-0.5	.	0.3	9.0
"U"	.	9.3	-14.0	-0.7	.	0.5	9.8
"V"	.	10.0	7.3	0	.	0	0
"W"	.	10.6	2.7	0.6	.	0.4	1.6
"X"	.	9.4	2.2	-0.6	.	0.4	-1.3
"Y"	.	10.6	2.2	0.6	.	0.4	1.3
"Z"	.	9.4	-15.0	-0.6	.	0.4	9.0
"a"	.	11.8	15.8	1.8	.	3.2	28.4
"b"	.	9.7	-40.0	-0.3	.	0.1	12.0
"c"	.	11.1	4.2	1.1	.	1.2	4.6
"d"	.	11.0	12.5 .	1.0	.	1.0	12.5
	.	prov.mean 10.0				Σy^2=116.2	Σxy=79.4
					corrected	113.5	-78.7

Correlation Coefficient of Intelligence and Acc. of Movement, (r).

Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{-76.7}{\sqrt{6379.6 \times 113.5}}$$

$$= \frac{-76.7}{79.87 \times 10.63}$$

$$= \frac{-76.7}{850}$$

$$= \underline{-0.090}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.09)^2}{5.48}$$

$$= \frac{1 - 0.0081}{5.48}$$

$$= \underline{0.182}$$

Probable error of r $= 0.674 \times 0.182$

$$= \underline{0.122}$$

Correlation of Cube Building and Formboards.

GROUP 1.

Subject	Cube-Building	Form-boards.	x	y	x^2	y^2	xy
"A"	1.7	1.8	-4.3	-2.2	18.4	4.8	9.5
"B"	3.3	2.7	-2.7	-1.3	7.3	1.7	3.5
"C"	8.4	4.7	2.4	0.7	5.8	0.5	1.6
"D"	4.4	1.9	-1.6	-2.1	2.6	4.4	3.4
"E"	7.0	2.6	1.0	-1.4	1.0	2.0	-1.4
"F"	2.3	4.4	-3.7	0.4	13.6	0.2	-1.5
"G"	6.8	4.2	0.8	0.2	0.6	0.04	0.1
"H"	5.0	4.4	-1.0	0.4	1.0	0.2	-0.4
"I"	8.5	7.7	2.5	3.7	6.3	13.5	9.3
"J"	3.2	4.8	-2.8	0.8	7.8	0.6	-2.2
"K"	7.7	3.1	1.7	-0.9	2.9	0.8	-1.5
"L"	8.7	4.7	2.7	0.7	7.3	0.5	1.9
"M"	2.8	3.8	-3.2	-0.2	10.2	0.04	0.6
"N"	3.0	5.5	-3.0	1.5	9.0	2.3	-4.5
"O"	6.4	5.7	0.4	1.7	0.2	2.9	0.6
"P"	12.3	6.0	6.3	2.0	39.6	4.0	12.6
"Q"	9.0	3.8	3.0	-0.2	9.0	0.04	-0.6
"R"	6.3	3.7	0.3	-0.3	0.1	0.1	-0.1
"S"	18.9	6.6	12.9	2.6	166.0	6.8	33.5
"T"	2.7	5.0	-3.3	1.0	10.9	1.0	-3.3
"U"	2.2	2.5	-3.8	-1.5	14.4	2.3	5.7
"V"	4.7	2.9	-1.3	-1.1	1.7	1.2	1.9
"W"	6.5	3.4	0.5	-0.6	0.3	0.4	-0.3
"X"	4.5	5.8	-1.5	1.8	2.3	3.2	-2.7
"Y"	5.2	3.5	-0.8	-0.5	0.6	0.3	0.4
"Z"	7.9	2.5	1.9	-1.5	3.6	2.3	-2.9
"a"	5.2	7.9	-0.8	3.9	0.6	15.2	-3.1
"b"	7.2	4.3	1.2	0.3	1.4	0.1	0.4
"c"	5.9	3.9	-0.1	-0.1	0	0.01	0
"d"	14.5	7.3	8.5	3.3	72.0	10.9	28.1
	Prov.mean 6.0	Prov.mean 4.0			x^2 = 416.5	y^2 = 82.3	xy 89.6
				Corrected	411.4	77.5	88.[illegible]

Correlation Coefficient of Cube Building and Formboards, (r).

Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{84.8}{\sqrt{411.7 \times 77.5}}$$

$$= \frac{84.8}{20.29 \times 8.81}$$

$$= \frac{84.8}{179}$$

$$= \underline{0.475}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no of subjects.

$$= \frac{1 - (0.475)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.225}{5.48}$$

$$= \frac{0.775}{5.48}$$

$$= \underline{0.141}$$

Probable error of $r = 0.674 \times 0.141$

$$= \underline{0.095}$$

Correlation of Cubebuilding and Stripbuilding.

Group 1.

Subject	Cube-building	Strip-building	x	y	x^2	y^2	xy
"A"	1.7	3.5	-4.3	-3.5	18.4	12.3	15.1
"B"	3.3	5.3	-2.7	-1.7	7.3	2.9	4.6
"C"	8.4	8.1	2.4	1.1	5.8	1.2	2.6
"D"	etc.	etc.	-1.6	-2.2	etc.	etc.	3.5
"E"	average	average	1.0	2.0	Σx^2 =	Σy^2 =	2.0
"F"	6.4	7.35	-3.7	-1.3	416.5	165.1	4.8
"G"	prov.mean	prov.mean	0.8	3.1	corrected	corrected	2.5
"H"	6.0	7.0	-1.0	0	411.7	161.9	0
"I"			2.5	2.6			6.5
"J"			-2.8	-2.0			5.6
"K"			1.7	-1.4			-2.4
"L"			2.7	1.1			3.0
"M"			-3.2	0.2			-0.6
"N"			-3.0	-3.0			9.0
"O"			0.4	1.3			0.5
"P"			6.3	3.4			21.4
"Q"			3.0	1.2			3.6
"R"			0.3	0.7			0.2
"S"			12.9	5.8			74.8
"T"			-3.3	-1.9			6.3
"U"			-3.8	-2.5			9.5
"V"			-1.3	-2.1			2.7
"W"			0.5	2.2			1.1
"X"			-1.5	-1.8			2.7
"Y"			-0.8	0.7			-0.6
"Z"			1.9	0			0
"a"			-0.8	-0.1			0.1
"b"			1.2	1.9			2.3
"c"			-0.1	1.5			-0.2
"d"			8.5	5.3			45.1
							Σxy = 225.7 corrected 221.5

Correlation Coefficient of Cubebldlng and Stripbuilding (r)

Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{221.5}{\sqrt{411.7 \times 161.9}}$$

$$= \frac{221.5}{20.28 \times 12.72}$$

$$= \underline{0.855.}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.855)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.731}{5.48}$$

$$= \frac{0.269}{5.48}$$

$$= \underline{0.049}$$

Probable error of r $= 0.674 \times 0.049$

$$= \underline{0.033}$$

Correlation of Cube Building and Acc. of Movement (Blindfolded)

GROUP 1.

Subject	Cube-Building	Est. of Movement	x	y	x^2	y^2	xy
"A"	1.7	15.4	-4.3	-1.6	18.4	46.2	6.9
"B"	3.3	11.6	-2.7	-5.4	7.3	29.1	14.6
"C"	8.4	10.5	2.4	-6.5	5.8	42.2	-15.6
"D"	etc.	etc.	-1.6	-5.4	$\Sigma x^2 =$	$\Sigma y^2 =$	8.6
"E"	average	average	1.0	-5.7	416.5	1136.6	-5.7
"F"	6.4	17.3	-3.7	0.8	corrected	corrected	-3.0
"G"	prov.mean	prov.mean	0.8	1.7	411.7	1133.9	1.4
"H"	6.0	17.0	-1.0	1.1			-1.1
"I"			2.5	1.5			3.4
"J"			-2.8	-3.2			7.8
"K"			1.7	-0.4			-0.7
"L"			2.7	11.6			31.3
"M"			-3.2	-2.9			9.3
"N"			-3.0	-2.1			6.3
"O"			0.4	-4.2			-1.7
"P"			6.3	3.0			18.9
"Q"			3.0	-4.7			-14.1
"R"			0.3	-0.3			-0.1
"S"			12.9	22.0			284.0
"T"			-3.3	0.9			-3.0
"U"			-3.8	-6.7			25.4
"V"			-1.3	-0.3			0.4
"W"			0.5	12.4			6.2
"X"			-1.5	-0.9			1.4
"Y"			-0.8	1.5			-1.2
"Z"			1.9	-2.9			-5.5
"a"			-0.8	6.8			-5.4
"b"			1.2	-4.3			-5.2
"c"			-0.1	4.8			-0.5
"d"			8.5	-2.3			-19.5
						corr. = 340	$\Sigma xy =$ 343.8

Correlation Coefficient of Spat. Perception (Cube Building) and Accuracy of Movement (Blindfolded) (r) Group 1

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{340}{\sqrt{411.7 \times 1133.9}}$$

$$= \frac{340}{20.29 \times 33.7}$$

$$= \frac{340}{684}$$

$$= \underline{0.497}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.497)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.247}{5.48}$$

$$= \frac{0.753}{5.48}$$

$$= \underline{0.137}$$

Probable error of r = 0.674×0.137

$$= \underline{0.093}$$

Correlation of Cubebuilding (Sp.Perc.) and Acc. of Movement.

GROUP 1.

Subject	Cube-building	Acc. of Movement	x	y	x^2	y^2	xy
"A"	1.7	7.4	-4.3	-2.6	18.4	6.8	11.2
"B"	3.3	13.5	-2.7	3.5	7.3	12.2	-9.5
"C"	8.4	5.4	2.4	-4.6	5.8	21.2	-11.1
"D"	etc.	7.3	-1.6	-2.7	etc.	7.3	4.3
"E"	average	12.6	1.0	2.6	Σx^2 =	6.8	2.6
"F"	6.4	13.1	-3.7	3.1	416.5	9.6	-11.5
"G"	prov.mean	12.3	0.8	2.3	corrected	5.3	1.8
"H"	6.0	7.9	-1.0	-2.1	411.7	4.4	2.1
"I"		10.0	2.5	0		0	0
"J"		6.8	-2.8	-3.2		10.2	8.9
"K"		9.1	1.7	-0.9		0.8	-1.5
"L"		10.4	2.7	0.4		0.2	1.1
"M"		8.3	-3.2	-1.7		2.9	5.5
"N"		7.5	-3.0	-2.5		6.3	7.5
"O"		9.9	0.4	-0.1		0	-0
"P"		10.9	6.3	0.9		0.8	5.7
"Q"		10.7	3.0	0.7		0.5	2.1
"R"		6.5	0.3	-3.5		12.2	-1.1
"S"		9.1	12.9	-0.9		0.8	-11.6
"T"		9.5	-3.3	-0.5		0.3	1.7
"U"		9.3	-3.8	-0.7		0.5	2.7
"V"		10.0	-1.3	0		0	0
"W"		10.6	0.5	0.6		0.4	0.3
"X"		9.4	-1.5	-0.6		0.4	0.9
"Y"		10.6	-0.8	0.6		0.4	-0.5
"Z"		9.4	1.9	-0.6		0.4	-1.1
"a"		11.8	-0.8	1.8		3.2	-1.4
"b"		9.7	1.2	-0.3		0.1	-0.4
"c"		11.1	-0.1	1.1		1.2	-0.1
"d"		11.0	8.5	1.0		1.0	8.5
		average 9.7				Σy^2 = 116.2	Σxy = 16.9
		prov.mean 10.0				corrected 113.5	correcte 20.5

Correlation Coefficient of Cubebuilding (Sp.Perc.) and Accuracy of Movement (r) Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{20.5}{\sqrt{411.7 \times 113.5}}$$

$$= \frac{20.5}{216}$$

$$= \underline{0.095}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.095)^2}{5.48}$$

$$= \frac{1 - 0.008}{5.48}$$

$$= \frac{0.992}{5.48}$$

$$= \underline{0.181}$$

Probable error of $r = 0.674 \times 0.181$

$$= \underline{0.122}$$

Correlation of Formboards and Stripbuilding.

GROUP 1.

Subject	Form-boards	Strip-building	x	y	x^2	y^2	xy
"A"	1.8	3.5	-2.2	-3.5	4.8	12.3	7.7
"B"	2.7	5.3	-1.3	-1.7	1.7	2.9	2.2
"C"	4.7	8.1	0.7	1.1	0.5	1.2	0.8
"D"	etc.	etc.	-2.1	-2.2	etc.	etc.	4.6
"E"	average	average	-1.4	2.0	Σx^2 =	Σy^2 =	-2.8
"F"	4.37	7.35	0.4	-1.3	82.3	165.1	-0.5
"G"	prov.mean	prov.-mean.	0.2	3.1	corrected	corrected	0.6
"H"	4.0	7.0	0.4	0	77.5	161.9	0
"I"			3.7	2.6			9.6
"J"			0.8	-2.0			-1.6
"K"			-0.9	-1.4			1.3
"L"			0.7	1.1			0.8
"M"			-0.2	0.2			0
"N"			1.5	-3.0			-4.5
"O"			1.7	1.3			2.2
"P"			2.0	3.4			6.8
"Q"			-0.2	1.2			-0.2
"R"			-0.3	0.7			-0.2
"S"			2.6	5.8			15.1
"T"			1.0	-1.9			-1.9
"U"			-1.5	-2.5			3.8
"V"			-1.1	-2.1			2.3
"W"			-0.6	2.2			-1.3
"X"			1.8	-1.8			-3.2
"Y"			-0.5	0.7			-0.4
"Z"			-1.5	0			0
"a"			3.9	-0.1			-0.4
"b"			0.3	1.9			0.6
"c"			-0.1	1.5			-0.2
"d"			3.3	5.3			17.5
							Σxy = 58.7 corrected 54.8

Correlation Coefficient of Formboards and Stripbuilding (r)

Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{54.8}{\sqrt{77.5 \times 161.9}}$$

$$= \frac{54.8}{8.8 \times 12.72}$$

$$= \underline{0.49}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.49)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.24}{5.48}$$

$$= \frac{0.76}{5.48}$$

$$= \underline{0.139}$$

Probable error of r $= 0.674 \times 0.139$

$$= \underline{0.093}$$

Correlation of Formboard and Acc. of Movement (Blindfolded)

GROUP 1.

Subject	Form-boards.	Est. of Movement	x	y	x^2	y^2	xy
"A"	1.8	15.4	-2.2	-1.6	4.8	2.6	3.5
"B"	2.7	11.6	-1.3	-5.4	1.7	29.1	7.0
"C"	4.7	10.5	0.7	-6.5	0.5	42.2	-4.6
"D"	etc.	etc.	-2.1	-5.4	etc. Σx^2 =	etc.	11.3
"E"	average	average	-1.4	-5.7	82.3	Σy^2 =	8.0
"F"	4.37	17.3	0.4	0.8	corrected	1136.6	0.3
"G"	prov.mean	prov.mean	0.2	1.7	77.5	corrected	0.3
"H"	4.0	17.0	0.4	1.1		1133.9	0.4
"I"			3.7	1.5			5.6
"J"			0.8	-3.2			-2.6
"K"			-0.9	-0.4			0.4
"L"			0.7	11.6			8.1
"M"			-0.2	-2.9			0.6
"N"			1.5	-2.1			-3.1
"O"			1.7	-4.2			-7.1
"P"			2.0	3.0			6.0
"Q"			-0.2	-4.7			0.9
"R"			-0.3	-0.3			0.1
"S"			2.6	22.0			57.0
"T"			1.0	0.9			0.9
"U"			-1.5	-6.7			10.0
"V"			-1.1	-0.3			0.3
"W"			-0.6	12.4			-7.4
"X"			1.8	-0.9			-1.6
"Y"			-0.5	1.5			-0.8
"Z"			-1.5	-2.9			4.4
"a"			3.9	6.8			26.3
"b"			0.3	-4.3			-1.3
"c"			-0.1	4.8			-0.5
"d"			3.3	-2.3			-7.3
"e"							
						corr. = 115.1	Σxy = 118.7

Correlation Coefficient of Spatial Perception (Formboards) and Accuracy of Movement (Blindfolded) (r) Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{115.1}{\sqrt{77.5 \times 1133.9}}$$

$$= \frac{115.1}{8.81 \times 33.7}$$

$$= \frac{115.1}{297}$$

$$= \underline{0.388}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.388)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.150}{5.48}$$

$$= \frac{1 - 0.150}{5.48}$$

$$= \frac{0.85}{5.48}$$

$$= \underline{0.155}$$

Probable error of $r = 0.674 \times 0.155$

$$= \underline{0.104}$$

Correlation of Formboards with Accuracy of Movement.

GROUP 1.

Subject	Form-boards	Acc. of Movement	x	y	x^2	y^2	xy
"A"	1.8	7.4	-2.2	-2.6	4.8	6.8	5.7
"B"	2.7	13.5	-1.3	3.5	1.7	12.2	-4.6
"C"	4.7	5.4	0.7	-4.6	0.5	21.2	-3.2
"D"	etc.	etc.	-2.1	-2.7	etc.	etc.	5.7
"E"	average	average	-1.4	2.6	Σx^2 =	Σy^2 =	-3.6
"F"	4.37	9.7	0.4	3.1	82.3	116.2	1.2
"G"	prov.mean	prov.mean	0.2	2.3	corrected	correct d	0.5
"H"	4.0	10.0	0.4	-2.1	77.5	113.5	-0.8
"I"			3.7	0			0
"J"			0.8	-3.2			-2.6
"K"			-0.9	-0.9			0.8
"L"			0.7	0.4			0.3
"M"			-0.2	-1.7			0.3
"N"			1.5	-2.5			-3.7
"O"			1.7	-0.1			-0.2
"P"			2.0	0.9			1.8
"Q"			-0.2	0.7			-0.1
"R"			-0.3	-3.5			1.1
"S"			2.6	-0.9			-2.3
"T"			1.0	-0.5			-0.5
"U"			-1.5	-0.7			1.1
"V"			-1.1	0			0
"W"			-0.6	0.6			-0.4
"X"			1.8	-0.6			-1.1
"Y"			-0.5	0.6			-0.3
"Z"			-1.5	-0.6			0.9
"a"			3.9	1.8			7.0
"b"			0.3	-0.3			-0.9
"c"			-0.1	1.1			-0.1
"d"			3.3	1.0			3.3
							Σxy = 5.3

Corr = 3.9

Correlation Coefficient of Formboards and Accuracy of Movement.

Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{8.9}{\sqrt{77.5 \times 113.5}}$$

$$= \frac{8.9}{93.75}$$

$$= \underline{0.095}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.095)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.008}{5.48}$$

$$= \frac{0.992}{5.48}$$

$$= \underline{0.181}$$

Probable error of $r = 0.674 \times 0.181$

$$= \underline{0.122}$$

Correlation of Stripbuilding and Acc. of Movement (Blindfolded)

GROUP 1.

Subject	Strip-building	Acc. of Movement	x	y	x^2	y^2	xy
"A"	3.5	15.4	-3.5	-1.6	12.3	2.6	5.6
"B"	5.3	11.6	-1.7	-5.4	2.9	29.1	9.2
"C"	8.1	10.5	1.1	-6.5	1.2	42.2	-7.2
"D"	etc.	etc.	-2.2	-5.4	etc.	etc.	11.9
"E"	average	average	2.0	-5.7	Σx^2 =	Σy^2 =	-11.4
"F"	7.35	17.3	-1.3	0.8	165.1	1136.6	-1.0
"G"	prov. mean	prov. mean	3.1	1.7	corrected	corrected	5.3
"H"	7.0	17.0	0	1.1	161.9	1133.9	0
"I"			2.6	1.5			3.9
"J"			-2.0	-3.2			6.4
"K"			-1.4	-0.4			0.6
"L"			1.1	11.6			12.8
"M"			0.2	-2.9			-0.6
"N"			-3.0	-2.1			6.3
"O"			1.3	-4.2			-5.5
"P"			3.4	3.0			10.2
"Q"			1.2	-4.7			-5.6
"R"			0.7	-0.3			-0.2
"S"			5.8	22.0			127.8
"T"			-1.9	0.9			-1.7
"U"			-2.5	-6.7			16.8
"V"			-2.1	-0.3			0.6
"W"			2.2	12.4			27.2
"X"			-1.8	-0.9			1.6
"Y"			0.7	1.5			1.1
"Z"			0	-2.9			0
"a"			-0.1	6.8			-0.7
"b"			1.9	-4.3			-8.2
"c"			1.5	4.8			7.2
"d"			5.3	-2.3			-12.2
							Σxy = 200.2 corrected 197.0

Correlation Coefficient of Stripbuilding and Accuracy of Movement (Blindfolded). (r) Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{197.0}{\sqrt{161.9 \times 1133.9}}$$

$$= \frac{197.0}{12.72 \times 33.67}$$

$$= \underline{0.460}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is no. of subjects.

$$= \frac{1 - (0.46)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.212}{5.48}$$

$$= \frac{0.788}{5.48}$$

$$= \underline{0.144}$$

Probable error of r $= 0.674 \times 0.144$

$$= \underline{0.097}$$

Correlation of Stripbuilding and Accuracy of Movement.

GROUP 1

Subject	Strip-building	Acc. of Movement	x	y	x^2	y^2	xy
"A"	3.5	7.4	-3.5	-2.6	12.3	6.8	9.1
"B"	5.3	13.5	-1.7	3.5	2.9	12.2	-5.9
"C"	8.1	5.4	-2.2	-2.7	1.2	21.2	5.9
"D"	etc.	etc.	2.0	2.6	etc.	etc.	5.2
"E"	average	average	-1.3	3.1	x^2 =	y^2 =	-4.0
"F" etc	7.35	9.7	3.1	2.3	165.1	116.2	7.2
"G"	prov.mean	prov.mean	0	-2.1	corrected	corrected	0
"H"	7.0	10.0	2.6	0	161.9	113.5	0
"I"			-2.0	-3.2			6.4
"J"			-1.4	-0.9			1.3
"K"			1.1	0.4			0.4
"L"			0.2	-1.7			-0.3
"M"			-3.0	-2.5			7.5
"N"			1.3	-0.1			-0.1
"O"			3.4	0.9			3.1
"P"			1.2	0.7			0.8
"Q"			0.7	-3.5			-2.5
"R"			5.8	-0.9			-5.2
"S"			-1.9	-0.5			1.0
"T"			-2.5	-0.7			1.8
"U"			-2.1	0			0
"V"			2.2	0.6			1.3
"W"			-1.8	-0.6			1.1
"X"			0.7	0.6			0.4
"Y"			0	-0.6			0.4
"Z"			-0.1	1.8			-0.2
"a"			1.9	-0.3			-0.6
"b"			1.5	1.1			1.7
"c"			5.3	1.0			5.3
"d"							Σxy = 38.4 corrected 38.6

Correlation Coefficient of Stripbuilding and Acc. of Movement.

(r) GROUP 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{38.6}{\sqrt{161.9 \times 113.5}}$$

$$= \frac{38.6}{12.72 \times 10.65}$$

$$= \underline{0.285}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is no. of subjects.

$$= \frac{1 - (0.285)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.081}{5.48}$$

$$= \frac{0.919}{4.48}$$

$$= \underline{0.168}$$

Probable error of r $= 0.674 \times 0.168$

$$= \underline{0.113}$$

Correlation of Estm. of Movement (Blindfld.) and Acc. of Movement

GROUP 1

Subject	Estm. of Movement	Acc. of Movement	x	y	x^2	y^2	xy
"A"	15.4	7.4	-1.6	-2.6	2.6	6.8	4.2
"B"	11.6	13.5	-5.4	3.5	29.1	12.2	-18.9
"C"	10.5	5.4	-6.5	-4.6	42.2	21.2	30.0
"D"	etc.	etc.	-5.4	-2.7	etc.	etc.	14.6
"E"	average	average	-5.7	2.6	$\Sigma x^2 =$	$\Sigma y^2 =$	-14.8
"F"	17.3	9.7	0.8	3.1	1136.6	116.2	2.5
"G"	prov.mean	prov.mean	1.7	2.3	corrected	corrected	3.9
"H"	17.0	10.0	1.1	-2.1	1133.9	113.5	-2.3
"I"			1.5	0			0
"J"			-3.2	-3.2			10.2
"K"			-0.4	-0.9			0.4
"L"			11.6	0.4			4.5
"M"			-2.9	-1.7			4.9
"N"			-2.1	-2.5			5.3
"O"			-4.2	-0.1			0.4
"P"			3.0	0.9			2.7
"Q"			-4.7	0.7			-3.3
"R"			-0.3	-3.5			1.1
"S"			22.0	-0.9			-20.0
"T"			0.9	-0.5			-0.5
"U"			-6.7	-0.7			4.7
"V"			-0.3	0			0
"W"			12.4	0.6			7.4
"X"			-0.9	-0.6			0.5
"Y"			1.5	0.6			0.9
"Z"			-2.9	-0.6			1.7
"a"			6.8	1.8			12.2
"b"			-4.3	-0.3			1.3
"c"			4.8	1.1			5.3
"d"			-2.3	1.0			-2.3
							$\Sigma xy =$ 56.6

CORR 59-3

Correlation Coefficient of Estm. of Movement (Blindfld.) and Accuracy of Movement. (r) Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{59.3}{\sqrt{1133.9 \times 113.5}}$$

$$= \frac{59.3}{33.68 \times 10.65}$$

$$= \underline{0.165}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.165)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.0272}{5.48}$$

$$= \frac{0.973}{5.48}$$

$$= \underline{0.177}$$

Probable error of r $= 0.674 \times 0.177$

$$= \underline{0.119}$$

Correlation of Eng. Ability with Sp. Perception (Cubebuilding)

GROUP 1.

Subject	Eng. Ability	Cube-Building	x	y	x^2	y^2	xy
"A"	5.0	1.7	-1.0	-4.3	1.0	18.4	4.3
"B"	7.0	3.3	1.0	-2.7	1.0	7.3	-2.7
"C"	7.5	8.4	1.5	2.4	2.3	5.8	3.6
"D"	etc.	etc.	-1.0	-1.6	etc.	etc.	1.6
"E"	average	average	-1.5	1.0	Σx^2 =	Σy^2 =	-1.5
"F"	6.046	6.4	-1.1	-3.7	62.4	416.5	4.1
"G"	say	prov.mean	-0.2	0.8		corrected	-0.2
"H"	6.0	6.0	-1.1	-1.0		411.7	1.1
"I"			0.8	2.5			2.0
"J"			-0.5	-2.8			1.4
"K"			-1.5	1.7			-2.6
"L"			-1.2	2.7			-3.2
"M"			-2.0	-3.2			6.4
"N"			-1.8	3.0			5.4
"O"			3.0	0.4			1.2
"P"			1.0	6.3			6.3
"Q"			1.1	3.0			3.3
"R"			0.1	0.3			0
"S"			2.5	12.9			32.2
"T"			-0.7	-3.3			2.3
"U"			2.6	-3.8			-9.9
"V"			-0.7	-1.3			0.9
"W"			-0.9	0.5			-0.5
"X"			-0.6	-1.5			0.9
"Y"			-0.3	-0.8			0.2
"Z"			1.2	1.9			2.3
"a"			0.8	-0.8			-0.6
"b"			-2.0	1.2			-2.4
"c"			1.8	-0.1			-0.2
"d"			2.2	8.5			18.7
							Σxy = 74.4
							corrected = 74.5

Correlation Coefficient of Eng. Ability and Sp. Perception

(Cubebuilding) (r) Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{74.5}{\sqrt{62.4 \times 411.7}}$$

$$= \frac{74.5}{\sqrt{7.9}}$$

$$= \frac{74.5}{7.9 \times 20.29}$$

$$= \frac{74.5}{160.1}$$

$$= \underline{0.465}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.465)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.216}{5.48}$$

$$= \frac{0.724}{5.48}$$

$$= \underline{0.132}$$

Probable error of r $= 0.674 \times 0.132$

$$= \underline{0.089}$$

Correlation of Eng. Ability and Sp. Perception (Formboards).

GROUPS 1.

Subject	Eng. Ability	Spatial Percept	x	y	x^2	y^2	xy
"A"	8.0	1.8	-1.0	-2.2	1.0	4.8	2.2
"B"	7.0	2.7	1.0	-1.3	1.0	1.7	-1.3
"C"	7.5	4.7	1.5	0.7	2.3	0.5	1.1
"D"	etc.	etc.	-1.0	-2.1	etc.	etc.	2.1
"E"	average	average	-1.5	-1.4	Σx^2 =	Σy^2 =	2.1
"F"	6.046	4.37	-1.1	0.4	62.4	82.3	-0.4
"G"	say	prov.mean	-0.2	0.2		corrected	-0
"H"	6.0	4.0	-1.1	0.4		77.5	-0.4
"I"			0.8	3.7			3.0
"J"			-0.5	0.8			-0.4
"K"			-1.5	-0.9			1.4
"L"			-1.2	0.7			-0.8
"M"			-2.0	-0.2			0.4
"N"			-1.8	1.5			-2.7
"O"			3.0	1.7			5.1
"P"			1.0	2.0			2.0
"Q"			1.1	-0.2			-0.2
"R"			0.1	-0.3			-0
"S"			2.5	2.6			6.5
"T"			-0.7	1.0			-0.7
"U"			2.6	-1.5			-3.9
"V"			-0.7	-1.1			0.8
"W"			-0.9	-0.6			0.5
"X"			-0.6	1.8			-1.3
"Y"			-0.3	-0.5			0
"Z"			1.2	-1.5			-1.8
"a"			0.8	3.9			3.1
"b"			-2.0	0.3			-0.6
"c"			1.8	-0.1			-0.2
"d"			2.2	3.3			7.3
							Σ xy = 22.9
						corrected	23.0

Correlation Coefficient of Eng. Ability and Formboards (r)

Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{23}{\sqrt{62.4 \times 82.3}}$$

$$= \frac{23}{7.9 \times 9.072}$$

$$= \frac{23}{71.7}$$

$$= \underline{0.314}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.314)^2}{\sqrt{30}}$$

$$= \frac{1 - 0.0986}{5.48}$$

$$= \frac{0.911}{5.48}$$

$$= \underline{0.166}$$

Probable error of r $= 0.674 \times 0.166$

$$= \underline{0.112}$$

Correlation of Eng. Ability and Spatial Percept. (Acc. of Movement Blindfolded)

GROUP 1.

Subject	Eng. Ability	Est. of Movement	x	y	x^2	y^2	xy
"A"	5.0	15.4	-1.0	-1.6	1.0	2.6	1.6
"B"	7.0	11.6	1.0	-5.4	1.0	29.1	-5.4
"C"	7.5	10.5	1.5	-6.5	2.3	42.2	-9.8
"D"	etc.	etc.	-1.0	-5.4	etc.	etc.	5.4
"E"	average	average	-1.5	-5.7	Σx^2 =	Σy^2 =	8.6
"F"	6.046	17.3	-1.1	0.8	62.4	1136.6	-0.9
"G"	say	prov.mean.	-0.2	1.7		corrected	-0.3
"H"	6.0	17.0	-1.1	1.1		1139.3	-1.2
"I"			0.8	1.5			1.2
"J"			-0.5	-3.2			1.6
"K"			-1.5	-0.4			0.6
"L"			-1.2	11.6			-13.9
"M"			-2.0	-2.9			5.8
"N"			-1.8	-2.1			3.8
"O"			3.0	-4.2			-12.6
"P"			1.0	3.0			3.0
"Q"			1.1	-4.7			-5.2
"R"			0.1	-0.3			0
"S"			2.5	2.2			33.0
"T"			-0.7	0.9			-0.6
"U"			2.6	-6.7			-17.4
"V"			-0.7	-0.3			0.2
"W"			-0.9	12.4			-11.2
"X"			-0.6	-0.9			0.5
"Y"			-0.3	1.5			-0.5
"Z"			1.2	-2.9			-3.5
"a"			0.8	6.8			5.5
"b"			-2.0	-4.3			8.6
"c"			1.8	4.8			8.6
"d"			2.2	-2.3			-5.1
							Σ xy= 0.4

Correlation Coefficient of Eng. Ability and Spatial Perception

(Acc. of Movement Blindfolded) (r) Group 1

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{0.4}{\sqrt{62.4 \times 1139.3}}$$

$$= \frac{0.4}{7.9 \times 33.74}$$

$$= \underline{0.0015}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.0015)^2}{\sqrt{30}}$$

$$= \frac{1}{5.48}$$

$$= \underline{0.182}$$

Probable error of $r = 0.674 \times 0.182$

$$= \underline{0.122}$$

Correlation of Eng. Ability and Acc. of Movement.

GROUP 1.

Subject	Eng. Ability	Acc. of Movement	x	y	x^2	y^2	xy
"AA	5.0	7.4	-1.0	-2.6	1.0	6.8	2.6
"B"	7.0	13.5	1.0	3.5	1.0	12.2	3.5
"C"	7.5	5.4	1.5	-4.6	2.3	21.2	-6.9
"D"	etc.	etc.	-1.0	-2.7	etc.	etc.	2.7
"E"	average	average	-1.5	2.6	Σx^2=	Σy^2 =	-3.9
"F"	6.046	9.7	-1.1	3.1	62.4	116.2	-3.4
"G"	say	prov.mean	-0.2	2.3		corrected	-0.5
"H"	6.0	10.0	-1.1	-2.1		113.5	2.3
"I"			0.8	0			0
"J"			-0.5	-3.2			1.6
"K"			-1.5	-0.9			1.4
"L"			-1.2	0.4			-0.5
"M"			-2.0	-1.7			3.4
"N"			-1.8	-2.5			4.5
"O"			3.0	-0.1			-0.3
"P"			1.0	0.9			0.9
"Q"			1.1	0.7			0.8
"R"			0.1	-3.5			-0.4
"S"			2.5	-0.9			-2.3
"T"			-0.7	-0.5			0.4
"U"			2.6	-0.7			-1.8
"V"			-0.7	0			0
"W"			-0.9	0.6			-0.5
"X"			-0.6	-0.6			0.4
"Y"			-0.3	0.6			-0.2
"Z"			1.2	-0.6			-0.7
"a"			0.8	1.8			1.4
"b"			-2.0	-0.3			0.6
"c"			1.8	1.1			2.0
"d"			2.2	1.0			2.2
							Σ xy = 9.3

Correlation Coefficient of Eng. Ability and Acc. of Movement

(r) Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{9.3}{\sqrt{62.4 \times 113.5}}$$

$$= \frac{9.3}{7.9 \times 10.65}$$

$$= \frac{9.3}{84.0}$$

$$= \underline{0.111}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.111)^2}{\sqrt{30.}}$$

$$= \frac{1 - 0.013}{5.48}$$

$$= \frac{0.987}{5.48}$$

$$= \frac{0.987}{4.48}$$

$$= \underline{0.180}$$

Probable error of r $= 0.674 \times 0.180$

$$= \underline{0.121}$$

Correlation of Intelligence and Spatial Percept. (Cubebuilding)

Group 2.

Subject	Intell-igence	Cube-building	x	y	x^2	y^2	xy
"I"	82.0	9.5	14.5	1.5	210.3	2.3	21.8
"II"	72.5	9.5	5.0	1.5	25.0	2.3	7.5
"III"	53.8	2.1	-13.7	-5.9	187.7	34.8	81.4
"IV"	etc.	etc.	-7.5	2.0	etc.	etc.	-15.0
"V"	average	average	17.8	-1.0	$\Sigma x^2 =$	$\Sigma y^2 =$	-17.8
"VI"	67.5	7.92	18.7	4.6	40.0.1	284.4	86.0
"VII"		prov.mean	3.5	2.4		corrected	8.4
"VIII"		8.0	17.5	2.8		284.1	49.0
"IX"			-26.3	-2.4			63.1
"X"			14.1	4.5			63.5
"XI"			9.5	2.4			22.8
"XII"			-2.5	-4.8			12.0
"XIII"			-0.9	0.7			-0.6
"XIV"			-10.5	1.9			-20.0
"XV"			-5.0	-1.1			5.5
"XVI"			-9.5	2.8			-26.6
"XVII"			3.0	-1.7			-5.1
"XVIII"			15.5	2.4			37.2
"XIX"			-12.0	-1.2			14.4
"XX"			5.6	-3.1			-17.8
"XXI"			7.5	0.3			2.3
"XXII"			-11.3	-5.5			62.1
"XXIII"			-0.3	-1.4			0.4
"XXIV"			-13.4	-2.3			30.8
"XXV"			-15.5	-2.8			43.4
"XXVI"			-13.9	-4.8			66.6
"XXVII"			10.5	7.0			73.5
							$\Sigma xy =$
							648.8

Correlation Coefficient of Intelligence and Spatial Perception

(Cubebuilding) (r) GROUP 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{648.8}{\sqrt{4010.1 \times 284.1}}$$

$$= \frac{648.8}{63.32 \times 16.86}$$

$$= \frac{648.8}{1068}$$

$$= \underline{0.608}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.608)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.370}{5.2}$$

$$= \frac{0.63}{5.2}$$

$$= \underline{0.121}$$

Probable error of $r = 0.674 \times 0.121$

$$= \underline{0.082}$$

Correlation of Intelligence and Spatial Percept. (Formboards)

GROUP 2.

Subject	Intelligence.	Formboards.	x	y	x^2	y^2	xy
"I"	82.0	3.2	14.5	-3.8	210.3	14.4	-55.1
"II"	72.5	6.0	5.0	-1.0	25.0	1.0	-5.0
"III"	53.8	3.0	-13.7	-4.0	187.7	16.0	54.8
"IV"	etc.	etc.	-7.5	-0.2	etc.	etc.	1.5
"V"	average	average	17.8	1.0	Σx^2 =	Σy^2 =	17.8
"VI"	67.5	6.75	18.7	8.0	4010.1	194.1	149.6
"VII"		prov.mean	3.5	0.5		corrected	1.8
"VIII"		7.0	17.5	3.4		192.5	59.5
"IX"			-26.3	-2.8			73.6
"X"			14.1	1.8			25.4
"XI"			9.5	-2.2			-20.9
"XII"			-2.5	-4.0			10.0
"XIII"			-0.9	0.6			-0.5
"XIV"			-10.5	1.6			-16.8
"XV"			-5.0	-1.7			8.5
"XVI"			-9.0	0.5			-4.5
"XVII"			3.0	-2.5			-7.5
"XVIII"			15.5	2.0			31.0
"XIX"			-12.0	-1.5			18.0
"XX"			5.6	2.0			11.2
"XXI"			7.5	2.5			18.6
"XXII"			-11.3	-1.6			18.1
"XXIII"			-0.3	1.7			0.5
"XXIV"			-13.4	-2.9			38.8
"XXV"			-15.5	-1.2			18.6
"XXVI"			-13.9	-1.5			20.9
"XXVII"			10.5	2.7			28.4
							Σxy=
							496.3

Correlation Coefficient of Intelligence and Spatial Perception (Formboards) (r) Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{496.3}{\sqrt{4010.1 \times 192.5}}$$

$$= \frac{496.3}{63.32 \times 13.87}$$

$$= \frac{496.3}{878.4}$$

$$= \underline{0.565}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.565)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.319}{5.2}$$

$$= \frac{0.681}{5.2}$$

$$= \underline{0.131}$$

Probable error of $r = 0.674 \times 0.131$

$$= \underline{0.0884}$$

Correlation of Intelligence and Spatial Percept. (Stripbuilding)

GROUP 2.

Subject	Intell-igence.	Strip-building	x	y	x^2	y^2	xy
"I"	82.0	10.1	14.5	1.1	210.3	1.2	16.0
"II"	72.5	7.2	5.0	-1.8	25.0	3.2	-9.0
"III"	53.8	4.0	-13.7	-5.0	187.7	25.0	68.5
"IV"	etc.	etc.	-7.5	-0.8	etc.	etc.	6.0
"V"	average	average	17.8	3.0	Σx^2 =	Σy^2 =	53.4
"VI"	67.5	9.048	18.7	2.3	4010.1	123.8	43.0
"VII"		say	3.5	0.1			0.4
"VIII"		9.0	17.5	-0.7			-12.3
"IX"			-26.3	-1.9			50.0
"X"			14.1	4.7			66.2
"XI"			9.5	0.2			1.9
"XII"			-2.5	-4.1			10.3
"XIII"			-0.9	1.7			-1.5
"XIV"			-10.5	2.0			-21.0
"XV"			-5.0	-2.0			10.0
"XVI"			-9.0	1.4			-12.6
"XVII"			3.0	-0.1			-0.3
"XVIII"			15.5	0.8			12.4
"XIX"			-12.0	-1.3			15.6
"XX"			5.6	0.7			3.9
"XXI"			7.5	2.3			17.3
"XXII"			-11.3	-1.0			11.3
"XXIII"			-0.3	0.5			-0.2
"XXIV"			-13.4	-1.7			22.8
"XXV"			-15.5	-1.9			29.4
"XXVI"			-13.9	0			0
"XXVII			10.5	3.0			31.5
							Σxy =
							41360

Correlation Coefficient of Intelligence and Spatial Perception (Stripbuilding) (r) Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{413.0}{\sqrt{4010.1 \times 123.8}}$$

$$= \frac{413.0}{63.32 \times 11.12}$$

$$= \frac{413}{704.12}$$

$$= \underline{0.586}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.586)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.344}{5.2}$$

$$= \frac{0.656}{5.2}$$

$$= \underline{0.126}$$

Probable error of $r = 0.674 \times 0.126$

$$= \underline{0.085}$$

Correlation of Intelligence and Acc. of Movement. (Blindfolded)

GROUP 2.

Subject	Intelligence.	Acc. of Movement	x	y	x^2	y^2	xy
"I"	82.0	16.6	14.5	-3.4	210.3	11.6	-49.3
"II"	72.5	24.0	5.0	4.0	25.0	16.0	20.0
"III"	53.8	16.2	-13.7	-3.8	187.7	14.4	52.0
"IV"	etc.	etc.	-7.5	-2.0	etc.	etc.	15.0
"V"	avefage	average	17.8	-2.3	Σx^2 =	Σy^2=	-40.9
"VI"	67.5	20.03	18.7	10.0	4010.1	754.4	187.0
"VII"		say	3.5	7.8			27.3
"VIII"		20.0	17.5	-5.6			-96.2
"IX"			-26.3	-5.2			136.8
"X"			14.1	11.0			155.1
"XI"			9.5	-0.9			-8.6
"XII"			-2.5	-4.6			11.5
"XIII"			-0.9	-0.3			0.3
"XIV"			-10.5	7.0			-73.5
"XV"			-5.0	-6.2			31.0
"XVI"			-9.0	4.3			-38.7
"XVII"			3.0	-0.4			-1.2
"XVIII"			15.5	-2.0			-31.0
"XIX"			-12.0	-3.5			42.0
"XX"			5.6	-2.8			-15.7
"XXI"			7.5	9.4			69.5
"XXII"			-11.3	-6.5			73.4
"XXIII"			-0.3	-3.0			0.9
"XXIV"			-13.4	0.8			-10.6
"XXV"			-15.5	-5.2			80.5
"XXVI"			-13.9	-1.5			20.9
"XVII"			10.5	6.4			67.2
							Σxy = 624.7

Correlation Coefficient of Intelligence and Acc. of Movement.

(Blindfolded) (r) Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{624.7}{\sqrt{4010.1 \times 754.4}}$$

$$= \frac{624.7}{63.32 \times 27.46}$$

$$= \frac{624.7}{1739}$$

$$= \underline{0.359}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.359)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.129}{5.2}$$

$$= \frac{0.871}{5.2}$$

$$= \underline{0.168}$$

Probable error of r $= 0.674 \times 0.168$

$$= \underline{0.113}$$

Correlation of Intelligence and Accuracy of Movement.

GROUP 2.

Subject	Intell-igence.	Acc. of Movement	x	y	x^2	y^2	xy
"I"	82.0	10.1	14.5	0.5	210.3	0.3	7.3
"II"	72.5	9.2	5.0	-0.4	25.0	0.2	-2.0
"III"	53.8	10.7	-13.7	1.1	187.7	1.2	-15.1
"IV"	etc.	etc.	-7.5	0.8	etc.	etc.	-6.0
"V"	average	average	17.8	0.3	Σx^2 =	Σy^2 =	5.3
"VI"	67.5	9.6	18.7	0.8	4010.1	26.5	15.0
"VII"			3.5	-0.2			-0.7
"VIII"			17.5	-0.9			-15.8
"IX"			-26.3	-2.2			57.8
"X"			14.1	0.8			11.3
"XI"			9.5	-1.5			-14.3
"XII"			-2.5	-0.1			0.3
"XIII"			-0.9	-1.5			1.4
"XIV"			-10.5	0.2			-2.1
"XV"			-5.0	1.1			-5.5
"XVI"			-9.0	1.2			-10.8
"XVII"			3.0	0.1			0.3
"XVIII"			15.5	0.9			14.0
"XIX"			-12.0	2.0			-24.0
"XX"			5.6	-0.6			-3.4
"XXI"			7.5	-0.1			-0.8
"XVII"			-11.3	0.2			-2.3
"XXIII"			-0.3	-1.7			0.5
"XXIV"			-13.4	0.6			-8.0
"XXV"			-15.5	1.0			-15.5
"XXVI"			-13.9	-0.5			7.0
"XXVII"			10.5	-0.5			-5.3
							Σxy =
							11.4

Correlation Coefficient of Intelligence and Acc. of Movement. (r)

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{-11.4}{\sqrt{4010.1 \times 26.5}}$$

$$= -\frac{11.4}{63.32 \times 5.148}$$

$$= -\frac{11.4}{325.9}$$

$$= -0.035$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.035)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.001}{5.2}$$

$$= \frac{0.999}{5.2}$$

$$= 0.192$$

Probable error of $r = 0.674 \times 0.192$

$$= 0.130$$

Correlation of Cubebuilding and Formboards Expts.

Group 2.

Subject	Cube-building	Form-boards	x	y	x^2	y^2	xy
"I"	9.5	3.2	1.5	-3.8	2.3	14.4	-5.7
"II"	9.5	6.0	1.5	-1.0	2.3	1.0	-1.5
"III"	2.1	3.0	-5.9	-4.0	34.8	16.0	23.6
"IV"	10.0	6.8	2.0	-0.2	4.0	0	-0.4
"V"	7.0	8.0	-1.0	1.0	1.0	1.0	-1.0
"VI"	12.6	15.0	4.6	8.0	21.2	64.0	36.8
"VII"	10.4	7.5	2.4	0.5	5.8	0.3	1.2
"VIII"	10.8	10.4	2.8	3.4	7.8	11.6	9.5
"IX"	5.6	4.2	-2.4	-2.8	5.8	7.8	6.7
"X"	12.5	8.8	4.5	1.8	20.3	3.2	8.1
"XI"	10.4	4.8	2.4	-2.2	5.8	4.8	-5.3
"XII"	3.2	3.0	-4.8	-4.0	23.0	16.0	19.2
"XIII"	8.7	7.6	0.7	0.6	0.5	0.4	0.4
"XIV"	9.9	8.6	1.9	1.6	3.6	2.6	3.0
"XV"	6.9	-5.3	-1.1	-1.7	1.2	2.9	1.8
"XVI"	10.8	7.5	2.8	0.5	7.8	0.3	1.4
"XVII"	6.3	4.5	-1.7	-2.5	2.9	6.3	4.3
"XVIII"	10.4	9.0	2.4	2.0	5.8	4.0	4.8
"XIX"	6.8	5.5	-1.2	-1.5	1.4	2.3	1.8
"XX"	4.9	5.0	-3.1	-2.0	9.6	4.0	6.2
"XXI"	8.3	9.5	0.3	2.5	0.1	6.3	0.5
"XXII"	2.5	5.4	-5.5	-1.6	30.3	2.6	8.8
"XXIII"	6.6	8.7	-1.4	1.7	2.0	2.9	-2.4
"XXIV"	5.7	4.1	-2.3	-2.9	5.3	8.4	6.7
"XXV"	5.2	5.8	-2.8	-1.2	7.8	1.4	3.3
"XXVI"	3.2	5.5	-4.8	-1.5	23.0	2.3	7.2
"XXVII"	5.0	9.7	7.0	2.7	49.0	7.3	18.9
	Average	Average			Σx^2 =	Σy^2 =	Σxy =
	7.92	6.75			284.4	194.1	158.2
	Prov. Mean	Prov. Mean			corrected	corrected	corrected
	8.0	7.0			284.1	192.5	157.7

Correlation Coefficient of Cubebuilding and Formboards Expts.,

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{157.7}{\sqrt{234.1 \times 192.5}}$$

$$= \frac{157.7}{16.85 \times 13.88}$$

$$= \underline{0.674}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.674)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.454}{5.2}$$

$$= \frac{0.546}{5.2}$$

$$= \underline{0.105}$$

Probable error of r $= 0.674 \times 0.105$

$$= \underline{0.0709}$$

Correlation of Cubebuilding and Stripbuilding.

Group 2

Subject	Cube-building	Strip-building	x	y	x^2	y^2	xy
"I"	9.5	10.1	1.5	1.7	2.3	1.2	1.7
"II"	9.5	7.2	1.5	-1.8	2.3	3.2	-2.7
"III"	2.1	4.0	-5.9	-5.0	34.8	25.0	29.5
"IV"	etc.	8.2	2.0	-0.8	etc.	0.6	-1.6
"V"	average	12.0	-1.0	3.0	Σx^2 =	9.0	-3.0
"VI"	7.92	11.3	4.6	2.3	284.4	5.3	10.6
"VII"	prov.mean	9.1	2.4	0.1	corrected	0	0.2
"VIII"	8.0	8.3	2.8	-0.7	284.1	0.5	-2.0
"IX"		7.1	-2.4	-1.9		3.6	4.6
"X"		13.7	4.5	4.7		22.1	21.2
"XI"		9.2	2.4	0.2		0	0.5
"XII"		4.9	-4.8	-4.1		16.8	19.7
"XIII"		10.7	0.7	1.7		2.3	1.2
"XIV"		11.0	1.9	2.0		4.0	3.8
"XV"		7.0	-1.1	-2.0		4.0	2.2
"XVI"		10.4	2.8	1.4		2.0	3.9
"XVII"		8.9	-1.7	-0.1		0	0.2
"XVIII"		9.8	2.4	0.8		0.6	1.9
"XIX"		7.7	-1.2	-1.3		1.7	1.6
"XX"		9.7	-3.1	0.7		0.5	-2.2
"XXI"		11.3	0.3	2.3		5.3	0.7
"XXII"		8.0	-5.5	-1.0		1.0	5.5
"XXIII"		9.5	-1.4	0.5		0.3	-0.7
"XXIV"		7.3	-2.3	-1.7		2.3	3.9
"XXV"		7.1	-2.8	-1.9		3.6	5.3
"XXVI"		9.0	-4.8	0		0	0
"XXVII"		12.0	7.0	3.0		9.0	21.0
		average				Σy^2 =	Σxy =
		9.048				123.9	127.0
		prov.mean				corrected	corrected
		9.0				123.8	126.9

Correlation Coefficient of Cubebuilding and Stripbuilding, (r).

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{126.9}{\sqrt{284.1 \times 123.8}}$$

$$= \frac{126.9}{16.85 \times 11.12}$$

$$= \underline{0.68}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.68)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.462}{5.2}$$

$$= \frac{0.538}{5.2}$$

$$= \underline{0.1035}$$

Probable error of $r = 0.674 \times 0.1035$

$$= \underline{0.0696}$$

Correlation of Cubebuilding and Acc. of Movement (Blindfolded)

GROUP 2.

Subject	Cube-Building	Acc. of Movement	x	y	x^2	y^2	xy
"I"	9.5	16.6	1.5	-3.4	2.3	11.6	-5.1
"II"	9.5	24.0	1.5	4.0	2.3	16.0	6.0
"III"	2.1	16.2	-5.9	-3.8	34.8	14.4	22.4
"IV"	etc.	etc.	2.0	-2.0	etc.	etc.	-4.0
"V"	average	20.03	-1.0	-2.3	$\Sigma x^2 =$ 284.4	$\Sigma y^2 =$	2.3
"VI"	7.92	say	4.6	10.0	corrected	754.4	46.0
"VII"	prov.mean	20.0	2.4	7.8	284.1		18.7
"VIII"	8.0		2.8	-5.6			-15.7
"IX"			-2.4	-5.2			12.5
"X"			4.5	11.0			49.5
"XI"			2.4	-0.9			-2.2
"XII"			-4.8	-4.6			22.1
"XIII"			0.7	-0.3			-0.2
"XIV"			1.9	7.0			13.3
"XV"			-1.1	-6.2			6.8
"XVI"			2.8	4.3			12.1
"XVII"			-1.7	-0.4			0.7
"XVIII"			2.4	-2.0			-4.8
"XIX"			-1.2	-3.5			4.2
"XX"			-3.1	-2.8			8.7
"XXI"			0.3	9.4			2.8
"XXII"			-5.5	-6.5			35.8
"XXIII"			-1.4	-3.0			4.2
"XXIV"			-2.3	0.8			-1.8
"XXV"			-2.8	-5.2			14.6
"XXVI"			-4.8	-1.5			7.2
"XXVII"			7.0	6.4			44.8
							$\Sigma xy =$ 300.9 corrected 301.0

Correlation Coefficient of Cubebuilding and Acc. of Movement.

(Blindfolded) (r) Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{301}{\sqrt{284.1 \times 754.4}}$$

$$= \frac{301}{16.86 \times 27.46}$$

$$= \frac{301}{461.9}$$

$$= \underline{0.651}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.651)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.424}{5.2}$$

$$= \frac{0.576}{5.2}$$

$$= \underline{0.111}$$

Probable error of $r = 0.674 \times 0.111$

$$= \underline{0.0746}$$

Correlation of Cubebuilding and Accuracy of Movement.

GROUP 2.

Subject	Cube-Building	Acc. of Movement	x	y	x^2	y^2	xy
"I"	9.5	10.1	1.5	0.5	2.3	0.3	0.8
"II"	9.5	9.2	1.5	-0.4	2.3	0.2	-0.6
"III"	2.1	10.7	-5.9	1.1	34.8	1.2	-6.5
"IV"	etc.	etc.	2.0	0.8	etc.	etc.	1.6
"V"	average	average	-1.0	0.3	Σx^2 =	Σy^2 =	-0.3
"VI"	7.92	9.6	4.6	0.8	284.4	26.5	3.7
"VII"	say		2.4	-0.2	corrected		-0.5
"VIII"	8.0		2.8	-0.9	284.1		-2.5
"IX"			-2.4	-2.2			5.3
"X"			4.5	0.8			3.6
"XI"			2.4	-1.5			-3.6
"XII"			-4.8	-0.1			0.5
"XIII"			0.7	-1.5			-1.1
"XIV"			1.9	0.2			0.4
"XV"			-1.1	1.1			-1.2
"XVI"			2.8	1.2			3.4
"XVII"			-1.7	0.1			-0.2
"XVIII"			2.4	0.9			2.2
"XIX"			-1.2	2.0			-2.4
"XX"			-3.1	-0.6			1.9
"XXI"			0.3	-0.1			0
"XXII"			-5.5	0.2			-1.1
"XXIII"			-1.4	-1.7			2.4
"XXIV"			-2.3	0.6			-1.4
"XXV"			-2.8	1.0			-2.8
"XXVI"			-4.8	-0.5			2.4
"XXVII"			7.0	-0.5			-3.5
							Σxy =
							0.5

Correlation Coefficient of Cubebuilding and Acc. of Movement.

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{0.5}{\sqrt{284.1 \times 26.5}}$$

$$= \frac{0.5}{16.85 \times 5.15}$$

$$= \frac{0.5}{86.7}$$

$$= \underline{0.0058}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.0058)^2}{\sqrt{27}}$$

$$= \frac{1}{5.2}$$

$$= \underline{0.193}$$

Probable error of r $= 0.674 \times 0.193$

$$= \underline{0.130}$$

Correlation of Formboards and Stripbuilding.

Group 2.

Subject	Form-boards	Strip-building	x	y	x^2	y^2	xy
"I"	3.2	10.1	-3.8	1.1	14.4	1.2	-4.2
"II"	6.0	7.2	-1.0	-1.8	1.0	3.2	1.8
"III"	3.0	4.0	-4.0	-5.0	16.0	25.0	20.0
"IV"	etc.	etc.	-0.2	-0.8	Σx^2 =	Σy^2 =	0.2
"V"	average	average	1.0	3.0	194.1	123.9	3.0
"VI"	6.75	9.048	8.0	2.3	corrected	corrected	18.4
"VII"	prov.mean	prov.mean	0.5	0.1	192.5	123.8	0.1
"VIII"	7.0	9.0	3.4	-0.7			-2.4
"IX"			-2.8	-1.9			5.3
"X"			1.8	4.7			8.5
"XI"			-2.2	0.2			-0.4
"XII"			-4.0	-4.1			16.4
"XIII"			0.6	1.7			1.0
"XIV"			1.6	2.0			3.2
"XV"			-1.7	-2.0			3.4
"XVI"			0.5	1.4			0.7
"XVII"			-2.5	-0.1			0.3
"XVIII"			2.0	0.8			1.6
"XIX"			-1.5	-1.3			2.0
"XX"			2.0	0.7			1.4
"XXI"			2.5	2.3			5.8
"XXII"			-1.6	-1.0			1.6
"XXIII"			1.7	0.5			0.9
"XXIV"			-2.9	-1.7			4.9
"XXV"			-1.2	-1.0			1.2
"XXVI"			-1.5	0			0
"XXVII"			2.7	3.0			8.1
							Σxy =
							102.8
							corrected
							103.1

Correlation Coefficient of Formboards and Stripbuilding, (r).

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{103.1}{\sqrt{192.5 \times 123.8}}$$

$$= \frac{103.1}{13.88 \times 11.12}$$

$$= \underline{0.67}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.67)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.449}{5.2}$$

$$= \frac{0.551}{5.2}$$

$$= \underline{0.106}$$

Probable error of r $= 0.674 \times 0.106$

$$= \underline{0.0715}$$

Correlation of Formboards and Acc. of Movement. (Blindfolded)

Group 2

Subject	Form-boards	Acc. of Movement	x	y	x^2	y^2	xy
"I"	3.2	16.6	-3.8	-3.4	14.4	11.6	12.9
"II"	6.0	24.0	-1.0	4.0	1.0	16.0	-4.0
"III"	3.0	16.2	-4.0	-3.8	16.0	14.4	15.2
"IV"	etc.	etc.	-0.2	-2.0	etc.	etc.	0.4
"V"	average.	average	1.0	-2.3	Σx^2 =	Σy^2 =	-2.3
"VI"	6.75	20.03	8.0	10.0	194.1	754.4	80.0
"VII"	prov.mean	say	0.5	7.8	corrected		3.9
"VIII"	7.0	20.0	3.4	-5.6	192.5		-19.1
"IX"			-2.8	-5.2			14.1
"X"			1.8	11.0			19.8
"XI"			-2.2	-0.9			2.0
"XII"			-4.0	-4.6			18.4
"XIII"			0.6	-0.3			-0.2
"XIV"			1.6	7.0			11.2
"XV"			-1.7	-6.2			10.5
"XVI"			0.5	4.3			2.2
"XVII"			-2.5	-0.4			1.0
"XVIII"			2.0	-2.0			-4.0
"XIX"			-1.5	-3.5			5.3
"XX"			2.0	-2.8			-5.6
"XXI"			2.5	9.4			23.5
"XXII"			-1.6	-6.5			10.4
"XXIII"			1.7	-3.0			-5.1
"XXIV"			-2.9	0.8			-2.3
"XXV"			-1.2	-5.2			6.2
"XXVI"			-1.5	-1.5			2.3
"XXVII"			2.7	6.4			17.3
							Σxy =
							210.0
							correct.
							210.2

Correlation Coefficient of Formboards and Acc. of Movement.

(Blindfolded) (r) Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{210.2}{\sqrt{192.5 \times 754.4}}$$

$$= \frac{210.2}{13.88 \times 27.46}$$

$$= \frac{210.2}{381.0}$$

$$= \underline{0.551}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.551)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.305}{5.2}$$

$$= \frac{0.695}{5.2}$$

$$= \underline{0.134}$$

Probable error of $r = 0.674, \times 0.134$

$$= \underline{0.090}$$

Correlation of Formboards and Accuracy of Movement.

GROUP 2.

Subject	Form-boards	Acc. of Movement	x	y	x^2	y^2	xy
"I"	3.2	10.1	-3.8	0.5	14.4	0.3	-1.9
"II"	6.0	9.2	-0.4 -4.0	1.0 1.1	1.0	0.2	0.4 -4.4
"III"	3.0	10.7	-0.2	0.8	16.0	1.2	-0.2
"IV"	etc.	etc.	1.0	0.3	etc.	etc.	0.3
"V" etc	average	average	8.0	0.8	$\Sigma x^2 =$	$\Sigma y^2 =$	6.4
"VI"	6.75	9.6	0.5	-0.2	194.1	26.5	-0.1
"VII"	prov.mean		3.4	-0.9	corrected		-3.1
"VIII"	7.0		-2.8	-2.2	192.5		6.2
"IX"			1.8	0.8			1.4
"X"			-2.2	-1.5			3.3
"XI"			-4.0	-0.1			0.4
"XII"			0.6	-1.5			-0.9
"XIII"			1.6	0.2			0.3
"XIV"			-1.7	1.1			-1.9
"XV"			0.5	1.2			0.6
"XVI"			-2.5	0.1			-0.3
"XVII"			2.0	0.9			1.8
"XVIII"			-1.5	2.0			-3.0
"XIX"			2.0	-0.6			-1.2
"XX"			2.5	-0.1			-0.3
"XXI"			-1.6	0.2			-0.3
"XXII"			1.7	-1.7			-2.9
"XXIII"			-2.9	0.6			-1.7
"XXIV"			-1.2	1.0			-1.2
"XXV"			-1.5	-0.5			0.8
"XXVI"			2.7	-0.5			-1.4
"XXVII"							$\Sigma xy =$
							-2.9

Correlation Coefficient of Formboards and Acc. of Movement.

(r). Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{-2.9}{\sqrt{192.5 \times 26.5}}$$

$$= \frac{-2.9}{13.88 \times 5.15}$$

$$= \frac{-2.9}{71.4}$$

$$= \underline{-0.054.}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.054)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.003}{5.2}$$

$$= \underline{0.192}$$

Probable error of $r = 0.674 \times 0.192$

$$= \underline{0.130}$$

Correlation of Stripbuilding and Acc. of Movement (Blindfolded)

GROUP 2.

Subject	Strip-building	Acc. of Movement	x	y	x^2	y^2	xy
"I"	10.1	16.6	1.1	-3.4	1.2	11.6	-3.7
"II"	7.2	24.0	-1.8	4.0	3.2	16.0	- 7.2
"III"	4.0	16.2	-5.0	-3.8	25.0	1.4.	19.0
"IV"	etc.	etc.	-0.8	-2.0	etc.	etc.	1.6
"V"	average	average	3.0	-2.3	Σx^2 =	Σy^2 =	-6.9
"VI"	9.048	20.03	2.3	10.0	123.9	754.4	23.0
"VII"	say	say	0.1	7.8	corrected		0.8
"VIII"	9.0	20.0	-0.7	-5.6	123.8		3.9
"IX"			-1.9	-5.2			9.9
"X"			4.7	11.0			51.7
"XI"			0.2	-0.9			-0.2
"XII"			-4.1	-4.6			18.9
"XIII"			1.7	-0.3			-0.5
"XIV"			2.0	7.0			14.0
"XV"			-2.0	-6.2			12.4
"XVI"			1.4	4.3			6.0
"XVII"			-0.1	-0.4			0
"XVIII"			0.8	-2.0			-1.6
"XIX"			-1.3	-3.5			4.6
"XX"			0.7	-2.8			-2.0
"XXI"			2 3	9.4			21.6
"XXII"			-1.0	-0.5			0.5
"XXIII"			0.5	-3.0			-1.5
"XXIV"			-1.7	0.8			-1.4
"XXV"			1.0	-5.2			-5.2
"XXVI"			0	-1.5			0
"XXVII"			3.0	6.4			19.2
							Σxy =
							182.1

Correlation Coefficient of Stripbuilding and Accuracy of Movement. (Blindfolded) (r) Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{182.1}{\sqrt{123.8 \times 754.4}}$$

$$= \frac{182.1}{11.12 \times 27.46}$$

$$= \frac{182.1}{305.35}$$

$$= \underline{0.596}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.596)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.356}{5.2}$$

$$= \frac{0.644}{5.2}$$

$$= \underline{0.124}$$

Probable error of r $= 0.674 \times 0.124$

$$= \underline{0.083}$$

Correlation of Stripbuilding and Accuracy of Movement.

Group 2.

Subject	Strip-building	Acc. of Movement	x	y	x^2	y^2	xy
"I"	10.1	10.1	1.1	0.5	1.2	0.3	0.6
"II"	7.2	9.2	-1.8	-0.4	3.2	0.2	0.7
"III"	4.0	10.7	-5.0	1.1	25.0	1.2	-5.5
"IV"	etc.	etc.	-0.8	0.8	etc.	etc.	-0.6
"V"	average	average	3.0	0.3	Σx^2 =	Σy^2 =	0.9
"VI"	9.048	9.6	2.3	0.8	123.9	26.5	1.8
"VII"	say.		0.1	-0.2	corrected		0
"VIII"	9.0		-0.7	-0.9	123.8		0.6
"IX"			-1.9	-2.2			4.2
"X"			4.7	0.8			3.8
"XI"			0.2	-1.5			-0.3
"XII"			-4.1	-0.1			0.4
"XIII"			1.7	-1.5			-2.6
"XIV"			2.0	0.2			0.4
"XV"			-2.0	1.1			-2.2
"XVI"			1.4	1.2			1.7
"XVII"			-0.1	0.1			0
"XVIII"			0.8	0.9			0.7
"XIX"			-1.3	2.0			-2.6
"XX"			0.7	-0.6			-0.4
"XXI"			2.3	-0.1			-0.2
"XXII"			-1.0	0.2			-0.2
"XXIII"			0.5	-1.7			-0.9
"XXIV"			-1.7	0.6			-1.0
"XXV"			1.0	1.0			1.0
"XXVI"			0	-0.5			0
"XXVII"			3.0	-0.5			-1.5
							Σxy =
							— 1.2

Correlation Coefficient of Stripbuilding and Acc. of Movement (r)

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{-1.2}{\sqrt{123.8 \times 26.5}}$$

$$= \frac{-1.2}{11.12 \times 5.15}$$

$$= -\frac{1.2}{57.3}$$

$$= \underline{-0.021}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.021)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.000441}{5.2}$$

$$= \frac{0.999}{5.2}$$

$$= \underline{0.192}$$

Probable error of r $= 0.674 \times 0.192$

$$= \underline{0.130}$$

Correlation of Est. of Movement (Dist.) and Acc. of Movement.

Group 2.

Subject	Est. of Movement	Acc. of Movement	x	y	x^2	y^2	xy
"I"	16.6	10.1	-3.4	0.5	11.6	0.3	-1.7
"II"	24.0	9.2	4.0	-0.4	16.0	0.2	-1.6
"III"	16.2	10.7	-3.8	1.1	14.4	1.2	-4.2
"IV"	18.0	10.4	-2.0	0.8	4.0	0.6	-1.6
"V"	17.7	9.9	-2.3	0.3	5.3	0.1	-0.7
"VI"	30.0	10.4	10.0	0.8	100.0	0.6	8.0
"VII"	27.8	9.4	7.8	-0.2	60.8	0	-1.6
"VIII"	14.4	8.7	-5.6	-0.9	31.4	0.8	5.0
"IX"	14.8	7.4	-5.2	-2.2	27.0	4.8	11.5
"X"	31.0	10.4	11.0	0.8	121.0	0.6	9.0
"XI"	19.1	8.1	-0.9	-1.5	0.8	2.3	1.4
"XII"	15.4	9.5	-4.6	-0.1	21.2	0	0.5
"XIII"	19.7	8.1	-0.3	-1.5	0.1	2.3	0.5
"XIV"	27.0	9.8	7.0	0.2	49.0	0	1.4
"XV"	13.8	10.7	6.2	1.1	38.4	1.2	-6.8
"XVI"	24.3	10.8	4.3	1.2	18.5	1.4	5.2
"XVII"	19.8	9.7	-0.2	0.2	0.2	0	0
"XVIII"	18.0	10.5	-2.0	0.9	4.0	0.8	-1.8
"XIX"	16.5	11.6	-3.5	2.0	12.3	4.0	-7.0
"XX"	17.2	9.0	-2.8	-0.6	7.8	0.4	1.7
"XXI"	29.4	9.5	9.4	-0.1	88.4	0	-0.9
"XXII"	13.5	9.8	-6.5	0.2	42.3	0	-1.3
"XXIII"	17.0	7.9	-3.0	-1.7	9.0	2.9	5.1
"XXIV"	20.8	10.2	0.8	0.6	0.6	0.4	0.5
"XXV"	14.8	10.6	-5.2	1.0	27.0	1.0	-5.2
"XXVI"	18.5	9.1	-1.5	-0.5	2.3	0.3	0.8
"XXVII"	26.4	9.1	6.4	-0.5	41.0	0.3	-3.2
	average	average			Σx^2 =	Σy^2 =	Σxy =
	20.03	9.6			754.4	26.5	13.0
	prov.mean						
	20.0						

Correlation Coefficient of Est. of Movement (Dist.) and Accuracy of Movement, (r). Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{13}{\sqrt{754.4 \times 26.5}}$$

$$= \frac{13}{27.46 \times 5.15}$$

$$= \underline{0.092}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.092)^2}{\sqrt{27}}$$

$$= \frac{0.9915}{5.2}$$

$$= \underline{0.190}$$

Probable error of r $= 0.674 \times 0.190$

$$= \underline{0.121}$$

Correlation of Intelligence and Drawing.

GROUP 2

Subject	Intelligence.	Drawing	x	y	x^2	y^2	xy
"I"	82.0	7.6	14.5	1.1	289	1.2	16.0
"II"	72.5	6.4	5.0	-0.1	16	0	-0.5
"III"	53.8	- 1.3	-13.7	-5.2	1936	27.0	71.0
"IV"	etc.	5.4	-7.5	-1.1	etc.	1.2	8.2
"V"	Average	7.1	17.8	0.6	Σx^2 =	0.4	10.7
"VI"	67.5	7.5	18.7	1.0	4010	1.0	18.7
"VII"		7.7	3.5	1.2		1.4	4.2
"VIII"		5.0	17.5	-1.5		2.3	-25.5
"IX"		3.0	-26.3	-3.5		12.3	92.0
"X"		7.9	14.1	1.4		2.0	19.7
"XI"		7.1	9.5	0.6		0.4	5.2
"XII"		3.0	-2.5	-3.5		12.3	8.7
"XIII"		5.7	-0.9	-0.8		0.6	0.7
"XIV"		8.7	-10.5	2.2		4.8	-23.0
"XV"		4.1	-5.0	-2.5		5.8	12.0
"XVI"		8.1	-9.5	1.6		2.6	-15.2
"XVII"		7.1	3.0	0.6		0.4	1.8
"XVIII"		9.4	15.5	2.9		8.4	44.9
"XIX"		7.1	-12.0	0.6		0.4	-7.2
"XX"		7.6	5.6	1.1		1.2	6.2
"XXI"		8.7	7.5	2.2		4.8	16.5
"XXII"		6.2	-11.3	-0.3		0.1	3.4
"XXIII"		6.9	-0.3	0.4		0.2	-0.1
"XXIV"		5.6	-13.4	-0.9		0.8	12.0
"XXV"		5.5	-15.5	-1.0		1.0	15.5
"XXVI"		6.5	-13.9	0		0	-0
"XXVII"		7.9	10.5	1.4		2.0	14.7
		174.1				Σy^2 =	Σxy =
		average				94.6	312.6
		6.45					
		say 6.5					

Correlation Coefficient of Intelligence and Drawing. (r)

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{312.6}{\sqrt{4010.0 \times 94.6}}$$

$$= \frac{312.6}{63.32 \times 9.7}$$

$$= \underline{0.51}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - r^2}{\sqrt{27}}$$

$$= \frac{1 - 0.26}{5.2}$$

$$= \frac{0.74}{5.2}$$

$$= \underline{0.142}$$

Probable error of r $= 0.674 \times 0.142$

$$= \underline{0.096}$$

Correlation of Intelligence and Patternmaking.

GROUP 2

Subject	Intelligence.	Pattern-making.	x	y	x^2	y^2	xy
"I"	82.0	8.9	14.5	1.9	289	3.6	27.6
"II"	72.5	6.8	5.0	-0.2	16	0	-1.0
"III"	53.8	2.4	-13.7	-4.6	1936	21.2	63.0
"IV"	etc.	4.6	-7.5	-2.4	etc.	5.8	18.0
"V"	average	6.4	17.8	-0.6	Σx^2 =	0.4	-10.7
"VI"	67.5	8.5	18.7	1.5	4010	2.3	28.0
"VII"		9.3	3.5	2.3		5.3	8.1
"VIII"		5.2	17.5	-1.8		3.2	-31.5
"IX"		6.1	-23.6	-0.9		0.8	21.2
"X"		9.8	14.1	2.8		7.8	39.4
"XI"		6.5	9.5	-0.5		0.3	-4.8
"XII"		2.3	-2.5	-4.7		22.1	11.8
"XIII"		9.5	-0.9	2.5		6.3	-2.3
"XIV"		9.6	-10.5	2.6		6.8	-27.3
"XV"		5.8	-5.0	-1.2		1.4	6.0
"XVI"		9.2	-9.5	2.2		4.8	-20.9
"XVII"		7.7	3.0	0.7		0.5	2.1
"XVIII"		7.8	15.5	0.8		0.6	12.4
"XIX"		8.0	-12.0	1.0		1.0	-12.0
"XX"		8.8	5.6	1.8		3.2	10.1
"XXI"		8.9	7.5	1.9		3.6	14.2
"XXII"		6.9	-11.3	-0.1		0	1.1
"XXIII"		7.6	-0.3	0.6		0.4	-0.2
"XXIV"		7.9	-13.4	0.9		0.8	-12.1
"XXV"		8.3	-15.5	1.3		1.7	-20.1
"XXVI"		5.7	-13.9	-1.3		1.7	18.1
"XXVII"		5.8	10.5	-1.2		1.4	-12.6
		Average 7.2				Σy^2 = 107.0 corrected 106.0	Σxy = 125.6
		Prov.Mean 7.0					

Correlation Coefficient of Intelligence and Patternmaking, (r).

Group 2.

$$r = \frac{xy}{\sqrt{x^2 \; y^2}} = \frac{125.6}{\sqrt{4010 \quad 106}}$$

$$= \frac{125.6}{63.3 \quad 10.3}$$

$$= \underline{0.193}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.193)^2}{5.2}$$

$$= \frac{1 - 0.037}{5.2}$$

$$= \frac{0.963}{5.2}$$

$$= \underline{0.185}$$

Probable error of r $= 0.674 \times 0.185$

$$= \underline{0.125}$$

Correlation of Intelligence and Workshop.

GROUP 2.

Subject	Intelligence.	Workshop	x	y	x^2	y^2	xy
"I"	82.0	8.9	14.5	2.1	289	4.4	30.4
"II"	72.5	6.0	5.0	-0.8	16	0.6	-4.0
"III"	53.8	3.4	-13.7	-3.4	1936	11.6	46.5
"IV"	etc.	6.2	-7.5	-0.6	etc.	0.4	4.5
"V"	Average	6.0	17.8	-0.8	Σx^2 =	0.6	-14.2
"VI"	67.5	8.1	18.7	1.3	4010	1.7	24.3
"VII"		8.9	3.5	2.1		4.4	7.4
"VIII"		7.6	17.5	0.8		0.6	14.0
"IX"		7.3	-26.3	0.5		0.3	-13.2
"X"		8.4	14.1	1.6		2.6	22.6
"XI"		7.3	9.5	0.5		0.3	4.8
"XII"		1.7	-2.5	-5.1		26.0	12.8
"XIII"		6.9	-0.9	0.1		0	-0.1
"XIV"		6.8	-10.5	0		0	-0
"XV"		5.0	-5.0	-1.8		3.2	9.0
"XVI"		6.0	-9.5	-0.8		0.6	7.6
"XVII"		5.9	3.0	-0.9		0.8	-2.7
"XVIII"		6.4	15.5	-0.4		0.2	-6.2
"XIX"		7.6	-12.0	0.8		0.6	-9.6
"XX"		8.6	5.6	1.8		3.2	10.1
"XXI"		9.1	7.5	2.3		5.3	17.3
"XXII"		6.9	-11.3	0.1		0	-1.1
"XXIII"		8.2	-0.3	1.4		2.0	-0.4
"XXIV"		6.7	-13.4	-0.1		0	1.3
"XXV"		6.5	-15.5	-0.3		0.1	4.7
"XXVI"		7.1	-13.9	0.3		0.1	-4.2
"XXVII"		6.4	10.5	-0.4		0.2	-4.2
		Average				Σy^2 =	Σxy =
		6.8				69.8	157.4

Correlation Coefficient of Intelligence and Workshop. (r).

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{157.4}{\sqrt{4010 \times 69.8}}$$

$$= \frac{157.4}{63.3 \times 8.35}$$

$$= \underline{0.298}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no of subjects.

$$= \frac{1 - (0.298)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.0888}{5.2}$$

$$= \frac{0.911}{5.2}$$

$$= \underline{0.175}$$

Probable error of r $= 0.674 \times 0.175$

$$= \underline{0.118}$$

Correlation of Drawing and Patternmaking.

Group 2

Subject	Drawing	Pattern-making	x	y	x^2	y^2	xy
"I"	7.6	8.9	1.1	1.9	1.2	3.6	2.1
"II"	6.4	6.8	-0.1	-0.2	0	0	0
"III"	1.3	2.4	-5.2	-4.6	27.0	21.2	23.9
"IV"	etc.	etc.	-1.1	-2.4	etc.	etc.	2.6
"V"	Average	Average	0.6	-0.6	Σx^2 =	Σy^2 =	-0.4
"VI"	6.45	7.2	1.0	1.5	94.6	107.0	1.5
"VII"	say	say	1.2	2.3		corrected	2.8
"VIII"	6.5	7.0	-1.5	-1.8		106.0	2.7
"IX"			-3.5	-0.9			3.2
"X"			1.4	2.8			3.9
"XI"			0.6	-0.5			-0.3
"XII"			-3.5	-4.7			16.5
"XIII"			-0.8	2.5			-2.0
"XIV"			2.2	2.6			5.7
"XV"			-2.4	-1.2			2.9
"XVI"			1.6	2.2			3.5
"XVII			0.6	0.7			0.4
"XVIII"			2.9	0.8			2.3
"XIX"			0.6	1.0			0.6
"XX"			1.1	1.8			2.0
"XXI"			2.2	1.9			4.2
"XXII"			-0.3	-0.1			0
"XXIII"			0.4	-0.6			-0.2
"XXIV"			-0.9	0.9			-0.8
"XXV"			-0.1	1.3			-1.3
"XXVI"			0	-1.3			0
"XXVII"			1.4	-1.2			-1.7
							Σxy = 72.1

Correlation Coefficient of Drawing and Patternmaking; (r).

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{72.1}{\sqrt{94.6 \times 106}}$$

$$= \frac{72.1}{9.7 \times 10.3}$$

$$= \underline{0.72}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.72)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.52}{5.2}$$

$$= \frac{0.48}{5.2}$$

$$= \underline{0.092}$$

Probable error of $r = 0.674 \times 0.092$

$$= \underline{0.062}$$

Correlation of Drawing and Workshop.

Group 2.

Subject	Drawing	Work-shop.	x	y	x^2	y^2	xy
"I"	7.6	8.9	1.1	2.1	1.2	4.4	2.3
"II"	6.4	6.0	-0.1	-0.8	0.6	0.6	0.1
"III"	1.3	3.4	-5.2	-3.4	27.0	11.6	17.7
"IV"	Average	Average	-1.1	-0.6	etc.	etc.	0.7
"V"	6.45	6.8	0.6	-0.8	Σx^2 =	Σy^2 =	-0.5
"VI"	say		1.0	1.3	94.6	69.8	1.3
"VII"	6.5		1.2	2.1			2.5
"VIII"			-1.5	0.8			-1.2
"IX"			-3.5	0.5			-1.8
"X"			1.4	1.6			2.2
"XI"			0.6	0.5			0.3
"XII"			-3.5	-5.1			17.9
"XIII"			-0.8	0.1			-0.1
"XIV"			2.2	0			0
"XV"			-2.4	-1.8			4.3
"XVI"			1.6	-0.8			-1.3
"XVII"			0.6	-0.9			-0.5
"XVIII"			2.9	-0.4			-1.2
"XIX"			0.6	0.8			0.5
"XX"			1.1	1.8			2.0
"XXI"			2.2	2.3			5.1
"XXII"			-0.3	0.1			0
"XXIII"			0.4	1.4			0.6
"XXIV"			-0.9	-0.1			0.1
"XXV"			-1.0	-0.3			0.3
"XXVI"			0	0.3			0
"XXVII			1.4	-0.4			-0.6
							Σxy =
							50.7

Correlation Coefficient of Drawing and Workshop, (r).

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{50.7}{\sqrt{94.6 \times 69.8}}$$

$$= \frac{50.7}{9.7 \times 8.35}$$

$$= \underline{0.626}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.626)^2}{5.2}$$

$$= \frac{1 - 0.37}{5.2}$$

$$= \frac{0.63}{5.2}$$

$$= \underline{0.121}$$

Proba le error of r $= 0.121 \times 0.674$

$$= \underline{0.0816}$$

Correlation of Patternmaking and Workshop.

Group 2.

Subject	Pattern-Making.	Work-shop.	x	y	x^2	y^2	xy.
"I"	8.9	8.9	1.9	2.1	3.6	4.4	4.0
"II"	6.8	6.0	-0.2	-0.8	0	0.6	0.2
"III"	2.4	3.4	-4.6	-3.4	21.2	11.6	15.7
"IV"	etc.	etc.	-2.4	-0.6	etc.	etc.	1.4
"V"	average	average	-0.6	-0.8	Σx^2 =	Σy^2 =	0.5
"VI"	7.2	6.8	1.5	1.3	107.0	69.8	2.0
"VII"	say		2.3	2.1	corrected		4.8
"VIII"	7.0		-1.8	0.8	106.0		-1.4
"IX"			-0.9	0.5			-0.5
"X"			2.8	1.6			4.5
"XI"			-0.5	0.5			-0.3
"XII"			-4.7	-5.1			24.0
"XIII"			2.5	0.1			0.3
"XIV"			2.6	0			0
"XV"			-1.2	-1.8			2.2
"XVI"			2.2	-0.8			-1.8
"XVII"			0.7	-0.9			-0.6
"XVIII"			0.8	-0.4			-0.3
"XIX"			1.0	0.8			0.8
"XX"			1.8	1.8			3.2
"XXI"			1.9	2.3			4.6
"XXII"			-0.1	0.1			-0
"XXIII"			-0.6	1.4			-0.8
"XXIV"			0.9	-0.1			-0.1
"XXV"			1.3	-0.3			-0.4
"XXVI"			-1.3	0.3			-0.4
"XXVII"			-1.2	-0.4			0.5
							Σxy = 62.1

Correlation Coefficient of Patternmaking and Workshop, (r).

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{62.1}{\sqrt{106 \times 69.8}}$$

$$= \frac{62.1}{10.3 \times 8.35}$$

$$= \underline{0.815}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.815)^2}{5.2}$$

$$= \frac{1 - 0.663}{5.2}$$

$$= \frac{0.337}{5.2}$$

$$= \frac{0.337}{5.2}$$

$$= \underline{0.065}$$

Probable error of $r = 0.674 \times 0.065$

$$= \underline{0.0437}$$

Correlation of Intelligence and Engineering Ability.

GROUP 1.

Subject	Intelligence	Eng. Ability.	x	y	x^2	y^2	xy
"A"	45.2	5.0	-6.8	-1.0	46.2	1.0	6.8
"B"	39.5	7.0	-12.5	1.0	156.3	1.0	-12.5
"C"	65.1	7.5	13.1	1.5	171.6	2.3	19.7
"D"	26.7	5.0	-25.3	-1.0	640.1	1.0	25.3
"E"	54.2	4.5	2.2	-1.5	4.8	2.3	-3.3
"F"	47.0	4.9	-5.0	-1.1	25.0	1.2	5.5
"G"	40.3	5.8	-11.7	-0.2	136.9	0	2.3
"H"	66.1	4.9	14.1	-1.1	198.8	1.2	-15.5
"I"	49.2	6.8	-2.8	0.8	7.8	0.6	-2.2
"J"	54.0	5.5	2.0	-0.5	4.0	0.3	-1.0
"K"	55.2	4.5	3.2	-1.5	10.2	2.3	-4.8
"L"	44.0	4.8	-8.0	-1.2	64.0	1.4	9.6
"M"	53.1	4.0	1.1	-2.0	1.2	4.0	-2.2
"N"	51.2	4.2	-0.8	-1.8	0.6	3.2	1.4
"O"	73.5	9.0	21.5	3.0	462.3	9.0	64.5
"P"	46.8	7.0	5.2	1.0	27.0	1.0	5.2
"Q"	53.0	7.1	1.0	1.1	1.0	1.2	1.1
"R"	66.8	6.1	14.8	0.1	219.0	0	1.5
"S"	89.0	8.5	37.0	2.5	1369.0	6.3	92.5
"T"	34.0	5.3	-18.0	-0.7	324.0	0.5	12.6
"U"	37.0	8.6	-14.0	2.6	196.0	6.8	-36.4
"V"	59.3	5.3	7.3	-0.7	53.3	0.5	-5.1
"W"	54.7	5.1	2.7	-0.9	7.3	0.8	-2.4
"X"	54.2	5.4	2.2	-0.6	4.8	0.4	-1.3
"Y"	54.2	5.7	2.2	-0.3	4.8	0.1	-0.7
"Z"	37.0	7.2	-15.0	1.2	225.0	1.4	-18.0
"a"	67.8	6.8	15.8	0.8	249.6	0.6	12.6
"b"	12.0	4.0	-40.0	-2.0	1600.0	4.0	80.0
"c"	56.2	7.8	4.2	1.8	17.6	3.2	7.6
"d"	64.5	8.2	12.5	2.2	156.3	4.8	27.5
	Aver.51.7	Av.6.0			Σx^2=6379.6	Σy^2=62.4	Σxy=270.3

Prov.Mean 52.0

Correlation Coefficient of Intelligence and Engineering Ability,(r). (Group 1.)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{270.3}{\sqrt{6379.6 \times 62.4}} = \frac{270.3}{624.0} = \underline{0.434}$$

Standard Error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n = number of subjects.

$$= \frac{1 - 0.188}{\sqrt{30}}$$

$$= \frac{0.812}{5.48}$$

$$= \underline{0.148}$$

Probable Error of r = 0.674 × 0.148

$$= \underline{0.099}$$

Correlation of Intelligence and Spatial Perception.

GROUP 1.

Subject	Intell-igence.	Spatial Percept.	x	y	x^2	y^2	xy
"A"	45.2	2.3	-6.8	-3.7	46.2	13.7	25.2
"B"	39.5	3.8	-12.5	-2.2	156.3	4.8	27.5
"C"	65.1	7.1	13.1	1.1	171.6	1.2	14.4
"D"	etc.	3.7	-25.3	-2.3	etc.	5.3	58.1
"E"		6.2	2.2	0.2		0	0.4
"F"	Average	4.1	-5.0	-1.9	Σx^2 =	3.6	9.5
"G"	51.7	7.0	-11.7	1.0	6379.6	1.0	-11.7
"H"	Prov.Mean	5.5	14.1	-0.5		0.3	-7.1
"I"	52.0	8.6	-2.8	2.6		6.8	-7.3
"J"		4.3	2.0	-1.7		2.9	-3.4
"K"		5.5	3.2	-0.5		0.3	-7.1
"L"		7.2	-8.0	1.2		1.4	-9.6
"M"		4.6	1.1	-1.4		2.0	-1.5
"N"		4.2	-0.8	-1.8		3.2	1.4
"O"		6.8	21.5	0.8		0.6	17.2
"P"		9.6	5.2	3.6		13.0	18.7
"Q"		7.0	1.0	1.0		1.0	1.0
"R"		5.9	14.8	-0.1		0	-1.5
"S"		12.9	37.0	6.9		47.6	225.0
"T"		4.3	-18.0	-1.7		2.9	30.6
"U"		3.1	-14.0	-2.9		8.4	40.6
"V"		4.2	7.3	-1.8		3.2	-13.1
"W"		6.4	2.7	0.4		0.2	1.1
"X"		5.2	2.2	-0.8		0.6	-1.8
"Y"		5.5	2.2	-0.5		0.3	-1.1
"Z"		5.8	-15.0	-0.2		0	3.0
"a"		6.7	15.8	0.7		0.5	11.1
"b"		6.3	-40.0	0.3		0.6	-32.0
"c"		6.1	4.2	0.1		0	0.4
"d"		11.4	12.5	5.4		29.2	67.5
		Aver 6.1				Σx^2=154.3	Σy^2=491.9

Prov.Mean=6.0

Correlation Coefficient of Intelligence and Spatial Perception, (r). Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{491.9}{\sqrt{6379.6 \times 154.3}}$$

$$= \frac{491.9}{992.2}$$

$$= \underline{0.496}$$

Standard Error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n = no. of subjects.

$$= \frac{1 - 0.246}{\sqrt{30}}$$

$$= \frac{0.754}{5.48}$$

$$= \underline{0.137}$$

Probable Error of r = 0.674 X 0.137

$$= \underline{0.092}$$

Correlation of Intelligence and Accuracy of Movement.

GROUP 1.

Subject	Intelligence.	Accy. of Movement	x	y	x^2	y^2	xy
"A"	45.2	11.4	-6.8	-1.6	46.2	2.6	10.9
"B"	39.5	12.7	-12.5	-0.3	156.3	0.1	3.8
"C"	65.1	8.0	13.1	-5.0	171.6	25.0	-65.5
"D"		9.5	-25.3	-3.5		12.3	88.5
"E"	etc.	11.9	2.2	-1.1	etc.	1.2	-2.4
"F"		15.5	-5.0	2.5		6.3	-12.5
"G"	Average	15.5	-11.7	2.5	$\Sigma x^2 =$	6.3	-28.2
"H"	51.7	13.0	14.1	0	6379.6	0	0
"I"	Prov.Mean	14.3	-2.8	1.3		1.7	-3.6
"J"	52.0	10.3	2.0	-2.7		7.3	-5.4
"K"		12.9	3.2	-0.1		0	-0.3
"L"		19.5	-8.0	6.5		42.3	-52.0
"M"		11.2	1.1	-1.8		3.2	-2.0
"N"		11.2	-0.8	-1.8		3.2	1.4
"O"		11.4	21.5	-1.6		2.6	-33.6
"P"		15.5	5.2	2.5		6.3	13.0
"Q"		11.5	1.0	-1.5		2.3	-1.5
"R"		11.6	14.8	-1.4		2.0	-20.7
"S"		24.0	37.0	11.0		121.0	407.0
"T"		13.7	-18.0	0.7		0.5	-12.6
"U"		9.8	-14.0	-3.2		10.2	44.8
"V"		13.4	7.3	0.4		0.2	2.9
"W"		20.0	2.7	7.0		49.0	18.9
"X"		12.8	2.2	-0.2		0	-0.4
"Y"		14.6	2.2	1.6		2.6	3.5
"Z"		11.8	-15.0	-1.2		1.4	18.0
"-"		17.8	15.8	4.8		23.0	75.8

Correlation Coefficient of Intelligence and Accuracy of Movement, (r). Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{535.0}{\sqrt{6379.6 \times 346.9}}$$

$$= \frac{535.0}{1488.0}$$

$$= 0.360$$

Standard Error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n = no. of subjects.

$$= \frac{1 - 0.130}{\sqrt{30}}$$

$$= \frac{0.87}{5.48}$$

$$= 0.159$$

Probable Error of $r = 0.674 \times 0.159$

$$= 0.107$$

Correlation of Engineering Ability and Spatial Perception.

GROUP 1.

Subject	Eng. Ability	Spatial Percept.	x	y	x^2	y^2	xy
"A"	5.0	2.8	-1.0	-3.7	1.0	13.7	3.7
"B"	7.0	3.8	1.0	-2.2	1.0	4.8	-2.2
"C"	7.5	7.1	1.5	1.1	2.3	1.2	1.7
"D"			-1.0	-2.3			2.3
"E"	etc.	etc.	-1.5	0.2	etc.	etc.	-0.3
"F"			-1.1	-1.9			2.1
"G"	Average	Average	-0.2	1.0	$\Sigma x^2 =$	$\Sigma y^2 =$	-0.2
"H"	6.0	6.06	-1.1	-0.5	62.4	154.3	0.6
"I"		Prov. Mean= 6.0	0.8	2.6			2.1
"J"			-0.5	-1.7			0.9
"K"			-1.5	-0.5			0.8
"L"			-1.2	1.2			-1.4
"M"			-2.0	-1.4			2.8
"N"			-1.8	-1.8			3.2
"O"			3.0	0.8			2.4
"P"			1.0	3.6			3.6
"Q"			1.1	1.0			1.1
"R"			0.1	-0.1			0
"S"			2.5	6.9			17.3
"T"			-0.7	-1.7			1.2
"U"			2.6	-2.9			-7.5
"V"			-0.7	-1.8			1.3
"W"			-0.9	0.4			-0.4
"X"			-0.6	-0.8			0.5
"Y"			-0.3	-0.5			0.2
"Z"			1.2	-0.2			-0.2
"a"			0.8	0.8			0.6
"B"			-2.0	0.8			-1.6
"c"			1.8	0.1			0.2
"d"			2.2	5.4			11.9
							$\Sigma xy = 46.7$

Correlation Coefficient of Engineering Ability and Spatial Perception, (r). Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{46.7}{\sqrt{62.4 \times 154.3}}$$

$$= \frac{46.7}{97.9}$$

$$= \underline{0.478}$$

Standard Error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n = no. of subjects.

$$= \frac{1 - 0.228}{\sqrt{30}}$$

$$= \frac{0.772}{5.48}$$

$$= \underline{0.141}$$

Probable Error of r = 0.674×0.141

$$= \underline{0.095}$$

Correlation of Engineering Ability and Accuracy of Movement.

GROUP 1.

Subject	Eng. Ability	Accuracy of Move.	x	y	x^2	y^2	xy
"A"	5.0	11.4	-1.0	-1.6	1.0	2.6	1.6
"B"	7.0	12.7	1.0	-0.3	1.0	0.1	-0.3
"C"	7.5	8.0	1.5	-5.0	2.3	25.0	-7.5
"D"			-1.0	-3.5			3.5
"E"	etc.	etc.	-1.5	-1.1	etc.	etc.	1.7
"F"			-1.1	2.5			-2.8
"G"	Average	Average	-0.2	2.5	$\Sigma x^2 =$	$\Sigma y^2 =$	-0.5
"H"	6.0	13.16	-1.1	0	62.4	346.9	0
"I"		Prov. Mean	0.8	1.3			1.0
"J"		13.0	-0.5	-2.7			1.4
"K"			-1.5	-0.1			0.2
"L"			-1.2	6.5			-7.8
"M"			-2.0	-1.8			3.6
"N"			-1.8	-1.8			3.2
"O"			3.0	-1.6			-4.8
"P"			1.0	2.5			2.5
"Q"			1.1	-1.5			-1.7
"R"			0.1	-1.4			-0.1
"S"			2.5	11.0			27.5
"T"			-0.7	0.7			-0.5
"U"			2.6	-3.2			-8.3
"V"			-0.7	0.4			-0.3
"W"			-0.9	7.0			-6.0
"X"			-0.6	-0.2			0.1
"Y"			-0.3	1.6			-0.5
"Z"			1.2	-1.2			-1.4
"a"			0.8	4.8			3.8
"b"			-2.0	-1.8			3.6
"c"			1.8	3.5			6.8
"d"			2.2	-0.1			-0.2
							$\Sigma xy = 17.9$

Correlation Coefficient of Engineering Ability and Accuracy of Movement, (r). Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{17.9}{\sqrt{62.4 \times 346.9}}$$

$$= \frac{17.9}{147.0}$$

$$= \underline{0.122}$$

Standard Error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n = no. of subjects.

$$\frac{1 - 0.015}{\sqrt{30}}$$

$$= \frac{0.985}{5.48}$$

$$= \underline{0.180}$$

Probable Error of $r = 0.674 \times 0.180$

$$= \underline{0.121}$$

Correlation of Spatial Perception and Accuracy of Movement.

GROUP 1.

Subject	Spatial Percept.	Accy. of Movement	x	y	x^2	y^2	xy
"A"	2.3	11.4	-3.7	-1.6	13.7	2.6	5.9
"B"	3.8	12.7	-2.2	-0.3	4.8	0.1	0.7
"C"	7.1	8.0	1.1	-5.0	1.2	25.0	5.5
"D"			-2.3	-3.5			8.1
"E"	etc.	etc.	0.2	-1.1	etc.	etc.	-0.2
"F"			-1.9	2.5			-4.8
"G"	Average	Average	1.0	2.5	Σx^2 =	Σy^2=	2.5
"H"	6.06	13.16	-0.5	0	154.3	346.9	0
"I"	Prov. Mean	Prov. Mean	2.6	1.3			3.4
"J"	6.0	13.0	-1.7	-2.7			4.6
"K"			-0.5	-0.1			0.1
"L"			1.2	6.5			7.8
"M"			-1.4	-1.8			2.5
"N"			-1.8	-1.8			3.2
"O"			0.8	-1.6			-1.3
"P"			3.6	2.5			9.0
"Q"			1.0	-1.5			-1.5
"R"			-0.1	-1.4			0.1
"S"			6.9	11.0			75.9
"T"			-1.7	0.7			-1.2
"U"			-2.9	-3.2			9.3
"V"			-1.8	0.4			-0.7
"W"			0.4	7.0			2.8
"X"			-0.8	-0.2			0.2
"Y"			-0.5	1.6			-0.8
"Z"			-0.2	-1½			0.2
"a"			0.7	4.8			3.4
"b"			0.8	-1.8			-1.4
"c"			0.1	3.5			0.4
"d"			5.4	-0.1			-0.5

$\Sigma xy = 122.0$

Correlation Coefficient of Spatial Perception and Accuracy of Movement, (r). Group 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{122.0}{\sqrt{154.3 \times 346.9}}$$

$$= \frac{122.0}{230.5}$$

$$= \underline{0.530}$$

Standard Error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n = no. of subjects.

$$= \frac{1 - 0.281}{\sqrt{30}}$$

$$= \frac{0.719}{5.48}$$

$$= \underline{0.131}$$

Probable Error of r = 0.674×0.131

$$= \underline{0.088}$$

Correlation of Intelligence and Engineering Ability.

GROUP 2

Subject	Intell-igence.	Eng.Abil	x	y	x^2	y^2	xy
"I"	82.0	85	14.5	17	210.3	289	246.2
"II"	72.5	64	5.0	-4	25.0	16	-20.0
"III"	53.8	24	-13.7	-44	187.7	1936	602.0
"IV"	etc.	54	-7.5	-14	etc.	196	105.0
"V"	average	65	17.8	-3	Σx^2 =	9	-53.4
"VI"	67.5	80	18.7	12	4010.1	144	224.4
"VII"		86	3.5	18		324	63.0
"VIII"		59	17.5	-9		81	-157.5
"IX"		55	-26.3	-13		169	342.0
"X"		87	14.1	19		361	268.0
"XI"		70	9.5	2		4	19.0
"XII"		23	-2.5	-45		2025	112.5
"XIII"		74	-0.9	6		36	-5.4
"XIV"		84	-10.5	16		256	-168.0
"XV"		50	-5.0	-18		324	90.0
"XVI"		78	-9.5	10		100	-95.0
"XVII"		69	3.0	1		1	3.0
"XVIII"		79	15.5	11		121	170.5
"XIX"		76	-12.0	8		64	-96.0
"XX"		83	5.6	15		225	84.0
"XXI"		89	7.5	21		441	157.5
"XXII"		67	-11.3	-1		1	11.3
"XXIII"		76	-0.3	8		64	-2.4
"XXIV"		67	-13.4	-1		1	13.4
"XXV"		68	-15.5	0		0	0
"XXVI"		64	-13.9	-4		16	55.6
"XXVII"		67	10.5	-1		1	-10.5
		Average			Σy^2 = 7205		Σxy =
		68.2			corrected =		1959.2
		Prov.Mean			7203.9		
		68.0					

Correlation Coefficient of Intelligence and Engineering Ability, (r). Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{1959.2}{\sqrt{4010.1 \times 7203.9}}$$

$$= \frac{1959.2}{5310}$$

$$= \underline{0.370}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.37)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.137}{5.2}$$

$$= \frac{0.863}{5.2}$$

$$= \underline{0.166}$$

Probable error of r $= 0.674 \times 0.166$

$$= \underline{0.112}$$

Correlation of Intelligence and Spatial Perception.

GROUP 2.

Subject	Intelligence.	Spatial Percept.	x	y	x^2	y	xy
"I"	82.0	7.6	14.5	-0.3	210.3	0.1	-4.4
"II"	72.5	7.6	5.0	-0.3	25.0	0.1	-1.5
"III"	53.8	3.0	-13.7	-4.9	187.7	24.0	67.0
"IV"	60.0	8.3	-7.5	0.4	56.3	0.2	-3.0
"V"	85.3	9.0	17.8	1.1	316.8	1.2	19.2
"VI"	86.2	13.0	18.7	5.1	349.7	26.0	93.3
"VII"	71.0	9.0	3.5	1.1	12.3	1.2	3.9
"VIII"	85.0	9.8	17.5	1.9	306.3	3.6	33.2
"IX"	41.2	5.6	-26.3	-2.3	691.7	5.3	60.5
"X"	81.6	11.6	14.1	3.7	198.8	13.7	52.1
"XI"	77.0	8.1	9.5	0.2	90.3	0	1.9
"XII"	65.0	3.7	-2.5	-4.2	6.3	17.6	10.5
"XIII"	66.6	9.0	-0.9	1.1	0.8	1.2	-1.0
"XIV"	57.0	9.8	-10.5	1.9	110.3	3.6	-20.0
"XV"	62.5	6.4	-5.0	-1.5	25.0	2.3	7.5
"XVI"	58.0	9.6	-9.5	1.7	90.3	2.9	-16.2
"XVII"	70.5	6.6	3.0	-1.3	9.0	1.7	-3.9
"XVIII"	83.0	9.7	15.5	1.8	240.3	3.2	27.9
"XIX"	55.5	6.6	-12.0	-1.3	144.0	1.7	15.6
"XX"	73.1	6.5	5.6	-1.4	31.4	2.0	-7.8
"XXI"	75.0	9.7	7.5	1.8	56.3	3.2	13.5
"XXII"	56.2	5.3	-11.3	-2.6	127.7	6.8	29.4
"XXIII"	67.2	8.3	-0.3	0.4	.1	0.2	-0.1
"XXIV"	54.1	5.7	-13.4	-2.2	179.6	4.8	29.4
"XXV"	52.0	6.0	-15.5	-1.9	240.3	3.6	29.4
"XXVI"	53.6	5.9	-13.9	-2.0	193.2	4.0	27.8
"XXVII"	78.0	12.2	10.5	4.3	110.3	18.5	45.2
	Average	Average			Σx^2 =	Σy^2 =	Σxy =
	67.5	7.9			4010.1	152.7	511.4

Correlation Coefficient of Intelligence and Spatial Perception, (r). Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{511.4}{\sqrt{4010.1 \times 152.7}}$$

$$= \frac{511.4}{779}$$

$$= \underline{0.655}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{27}}$ where n is the no. of subjects

$$= \frac{1 - (0.655)^2}{5.2}$$

$$= \frac{1 - 0.423}{5.2}$$

$$= \frac{0.577}{5.2}$$

$$= \underline{0.111}$$

Probable error of r $= 0.674 \times 0.111$

$$= \underline{0.075}$$

Correlation of Intelligence and Accuracy of Movement.

GROUP 2.

Subject	Intell-igence.	Acc. of Movement	x	y	x^2	y^2	xy
"I"	82.0	13.8	14.5	-1.2	210.3	1.4	-17.4
"II"	72.5	16.6	5.0	1.6	25.0	2.6	8.0
"III"	53.8	13.5	-13.7	-1.5	187.7	2.3	20.6
"IV"	etc.	14.2	-7.5	-0.8	etc.	0.6	6.0
"V"	average	13.8	17.8	-1.2	Σx^2 =	1.4	-21.4
"VI"	67.5	20.2	18.7	5.2	4010.1	27.0	97.2
"VII"		18.6	3.5	3.6		13.0	12.6
"VIII"		11.5	17.5	-3.5		12.3	-61.2
"IX"		11.1	-26.3	-3.9		15.2	102.6
"X"		20.7	14.1	5.7		32.5	80.4
"XI"		13.6	9.5	-1.4		2.0	-13.3
"XII"		12.5	-2.5	-2.5		6.3	6.3
"XIII"		13.9	-0.9	-1.1		1.2	1.0
"XIV"		18.4	-10.5	3.4		11.6	-35.7
"XV"		12.2	-5.0	-2.8		7.8	14.0
"XVI"		17.6	-9.5	2.6		6.8	-24.7
"XVII"		14.6	3.0	-0.4		0.2	-1.2
"XVIII"		14.3	15.5	-0.7		0.5	-10.9
"XIX"		14.1	-12.0	-0.9		0.8	10.8
"XX"		13.1	5.6	-1.9		3.6	-10.6
"XXI"		19.5	7.5	4.5		20.3	33.8
"XXII"		11.6	-11.3	-3.4		11.6	38.4
"XXIII"		12.5	-0.3	-2.5		6.3	0.8
"XXIV"		15.5	-13.4	0.5		0.3	-6.7
"XXV"		12.7	-15.5	-2.3		5.3	25.6
"XXVI"		13.8	-13.9	-1.2		1.4	16.7
"XXVII"		17.7	10.5	2.7		7.3	28.4
		Average				Σy^2 =	Σxy =
		14.9				201.6	310.1
		Prov.Mean				corrected	
		15.0				201.3	

Correlation Coefficient of Intelligence and Accuracy of Movement, (r). Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{310.1}{\sqrt{4010.1 \times 201.3}}$$

$$= \frac{310.1}{897}$$

$$= \underline{0.346}$$

Standard error of r $$= \frac{1 - (0.346)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.119}{5.2}$$

$$= \underline{0.17}$$

Probable error of r $= 0.674 \times 0.17$

$$= \underline{0.114}$$

Correlation of Eng. Ability and Spatial Perception.

GROUP 2.

Subject	Eng. Abil	Spatial Percept.	x	y	x^2	y^2	xy
"I"	85	7.6	17	-0.3	289	0.1	-5.1
"II"	64	7.6	-4	-0.3	16	0.1	1.2
"III"	24	3.0	-44	-4.9	1936	24.0	215.6
"IV"	etc.	etc.	-14	0.4	Σx^2 =	Σy^2 =	-5.6
"V"	Average	Average	-3	1.1	7205	152.7	-0.3
"VI"	68.2	7.9	12	5.1	corrected		61.2
"VII"	Prov. Mean		18	1.1	7203.9		19.8
"VIII"	68.0		-9	1.9			-17.1
"IX"			-13	-2.3			29.9
"X"			19	3.7			70.3
"XI"			2	0.2			0.4
"XII"			-45	-4.2			189.0
"XIII"			6	1.1			6.6
"XIV"			16	1.9			30.2
"XV"			-18	-1.5			27.0
"XVI"			10	1.7			17.0
"XVII"			1	-1.3			-1.3
"XVIII"			11	1.8			19.8
"XIX"			8	-1.3			-10.4
"XX"			15	-1.4			-21.0
"XXI"			21	1.8			37.8
"XXII"			-1	-2.6			2.6
"XXIII"			8	0.4			3.2
"XXIV"			-1	-2.2			2.2
"XXV"			0	-1.9			-0
"XXVI"			4	-2.0			-8.0
"XXVII"			-1	4.3			-4.3
							Σxy = 660.7

Correlation Coefficient of Engineering Ability and Spatial Perception, (r). Group 2.

$$r = \frac{xy}{\sqrt{x^2 \quad y^2}} = \frac{660.7}{\sqrt{7203.9 \times 152.7}}$$

$$= \frac{660.7}{1048}$$

$$= \underline{0.63}$$

$$\text{Standard error of } r = \frac{1 - r^2}{\sqrt{n}}$$ where n is the no. of subjects.

$$= \frac{1 - (0.630)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.3969}{5.2}$$

$$= \underline{0.1161}$$

Probable error of r = 0.674×0.1161

$$= \underline{0.0782}$$

Correlation of Eng. Ability and Accuracy of Movement.

GROUP 2.

Subject	Eng. Ability.	Acc. of Move ent	x	y	x^2	y^2	xy
"I"	85	13.8	17	-1.2	289	1.4	-20.4
"II"	64	16.6	-4	1.6	16	2.6	-6.4
"III"	24	13.5	-44	-1.5	1936	2.3	66.0
"IV"	etc.	etc.	-14	-0.8	etc.	etc.	11.2
"V"	Average	Average	-3	-1.2	Σx^2 =	Σy^2 =	3.6
"VI"	68.2	14.9	12	5.2	7205	201.6	62.4
"VII"	Prov. Mean	Prov. Mean	18	3.6	corrected	corrected	64.8
"VIII"	68.0	15.0	-9	-3.5	7203.9	201.3	31.5
"IX"			-13	-3.9			50.7
"X"			19	5.7			108.2
"XI"			2	-1.4			-2.8
"XII"			-45	-2.5			112.5
"XIII"			6	-1.1			-6.6
"XIV"			16	3.4			54.4
"XV"			-18	-2.8			50.4
"XVI"			10	2.6			26.0
"XVII"			1	-0.4			-0.4
"XVIII"			11	-0.7			-7.7
"XIX"			8	-0.9			-7.2
"XX"			15	-1.9			-28.5
"XXI"			21	4.5			94.5
"XXII"			-1	-3.4			3.4
"XXIII"			8	-2.5			-20.0
"XXIV"			-1	0.5			-0.5
"XXV"			0	-2.3			0
"XXVI"			4	-1.2			-4.8
"XXVII"			-1	2.7			-2.7
							Σxy = 631.6
							Corrected 632.1

Correlation Coefficient of Engineering Ability and Accuracy of Movement, (r). Group 2

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{632.1}{\sqrt{7203.9 \times 201.3}}$$

$$= \frac{632.1}{1206}$$

$$= \underline{0.445}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no of subjects.

$$= \frac{1 - (0.445)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.194}{5.2}$$

$$= \frac{0.806}{5.2}$$

$$= \underline{0.155}$$

Probable error of r $= 0.674 \times 0.155$

$$= \underline{0.104}$$

Correlation of Spatial Perception and Acc. of Movement.

GROUP 2.

Subject	Spatial Percept.	Acc. of Movement	x	y	x^2	y^2	xy
"I"	7.6	13.8	-0.3	-1.2	0.1	1.4	0.4
"II"	7.6	16.6	-0.3	1.6	0.1	2.6	-0.5
"III"	3.0	13.5	-4.9	-1.5	24.0	2.3	7.4
"IV"	etc.	etc.	0.4	-0.8	etc.	etc.	-0.3
"V"	Average	Average	1.1	-1.2	Σx^2 =	Σy^2 =	-1.3
"VI"	7.9	14.9	5.1	5.2	152.7	201.6	26.0
"VII"		Prov.Mean	1.1	3.6		corrected	4.0
"VIII"		15.0	1.9	-3.5		201.3	-6.6
"IX"			-2.3	-3.9			9.0
"X"			3.7	5.7			21.1
"XI"			0.2	-1.4			-0.3
"XII"			-4.2	-2.5			10.5
"XIII"			1.1	-1.1			-1.2
"XIV"			1.9	3.4			6.5
"XV"			-1.5	-2.8			4.2
"XVI"			1.7	2.6			4.4
"XVII"			-1.3	-0.4			0.5
"XVIII"			1.8	-0.7			-1.3
"XIX"			-1.3	-0.9			1.2
"XX"			-1.4	-1.9			2.7
"XXI"			1.8	4.5			8.1
"XXII"			-2.6	-3.4			8.8
"XXIII"			0.4	-2.5			-1.0
"XXIV"			-2.2	0.5			-1.1
"XXV"			-1.9	-2.3			4.4
"XXVI"			-2.0	-1.2			2.4
"XXVII"			4.3	2.7			11.6
							Σxy = 119.6

Correlation Coefficient of Spatial Perception and Accuracy of Movement, (r). Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{119.6}{\sqrt{152.7 \times 201.3}}$$

$$= \frac{119.6}{175.1}$$

$$= \underline{0.68}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no of subjects.

$$= \frac{1 - (0.68)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.46}{5.2}$$

$$= \frac{0.52}{5.2}$$

$$= \underline{0.104}$$

Probable error of r $= 0.674 \times 0.104$

$$= \underline{0.07}$$

Correlation of Intelligence and Spatial Perception.

GROUP 3.

Subject	Intell-igence.	Spatial Percept.	x	y	x^2	y^2	xy
"1"	69.0	7.6	4.0	0.6	16.0	0.4	2.4
"2"	58.0	8.5	-7.0	1.5	49.0	2.3	-10.5
"3"	55.5	5.3	-9.5	-1.7	90.3	2.9	16.2
"4"	70.5	6.7	5.5	-0.3	30.3	0.1	-1.7
"5"	84.5	4.6	19.5	-2.4	380.3	5.8	-46.6
"6"	54.2	10.3	-10.8	3.3	116.6	10.9	-35.6
"7"	68.6	9.2	3.6	2.2	13.0	4.8	7.9
"8"	73.8	5.1	8.8	-1.9	77.4	3.6	-16.7
"9"	49.1	3.8	-15.9	-3.2	252.8	10.2	48.0
"10"	68.2	9.3	3.2	2.3	10.2	5.3	7.4
"11"	73.6	6.0	8.6	-0.9	74.0	0.8	-7.7
"12"	63.5	8.0	-1.5	1.0	2.3	1.0	-1.5
"13"	36.4	4.1	-28.6	-2.9	818.0	8.4	83.0
"14"	57.6	3.5	-7.4	-3.5	54.8	12.3	25.9
"15"	65.6	7.6	0.6	0.4	0.4	0.4	.4
"16"	52.6	7.9	-12.4	0.9	153.8	0.8	-11.2
"17"	71.0	11.2	6.0	4.2	36.0	17.6	25.2
"18"	46.8	6.1	-18.2	-0.9	331.2	0.8	16.4
"19"	73.0	7.2	8.0	0.2	64.0	0	1.6
"20"	66.1	3.8	1.1	-3.2	1.2	10.2	-3.5
"21"	67.4	3.4	2.4	-3.6	5.8	13.0	-8.6
"22"	67.4	7.4	2.4	0.4	5.8	0.2	1.0
"23"	90.0	11.5	25.0	4.5	625.0	20.3	112.5
"24"	69.0	6.0	4.0	-1.0	16.0	1.0	-4.0
"25"	68.0	5.7	3.0	-1.3	9.0	1.7	-3.9
"26"	59.0	8.3	-6.0	1.3	36.0	1.7	-7.8
"27"	62.0	2.9	-3.0	-4.1	9.0	16.8	12.3
"28"	46.0	5.9	-19.0	-1.1	361.0	1.2	20.9

Correlation of Intelligence and Spatial Perception (Cont.)

GROUP3.

Subject	Intell-igence.	Spatial Percept.	x	y	x^2	y^2	xy
"29"	55.0	5.8	-10.0	-1.2	100.0	1.4	12.0
"30"	86.5	11.2	21.5	4.2	462.3	17.6	90.3
"31"	78.1	4.6	13.1	-2.4	171.6	5.8	-31.4
"32"	59.6	9.1	-5.4	2.1	29.2	4.4	-11.3
	Average 64.55	Average 6.8			Σx^2 = 4402.3	Σy^2 = 183.7	Σxy = 291.4
	Prov. Mean 65.0	Prov. Mean 7.0			corrected =4388.9	corrected =182.4	corrected 287.2

Correlation Coefficient of Intelligence and Spatial Perception

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{287.2}{\sqrt{4388.9 \times 182.4}}$$

$$= \frac{287.2}{895.0} = 0.320$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects

$$= \frac{1 - (0.32)^2}{\sqrt{32}} = \frac{1 - 0.103}{5.66}$$

$$= \frac{0.897}{5.66} = 0.159$$

Probable error of r = 0.674 X 0.159

= 0.107

Correlation of Intelligence and Accuracy of Movement.

GROUP 3

Subject	Intell-igence.	Acc. of Movement	x	y	x^2	y^2	xy
"1"	69.0	15.3	4.0	1.3	16.0	1.7	5.2
"2"	58.0	12.6	-7.0	-1.4	49.0	2.0	9.8
"3"	55.5	11.5	-9.5	-2.5	90.3	6.3	23.8
"4"	etc.	12.9	5.5	-1.1	etc.	1.2	-6.1
"5"	Average	11.3	19.5	-2.7	Σx^2 =	7.3	-52.6
"6"	64.55	13.5	-10.8	-0.5	4388.9	0.3	5.4
"7"	Prov.Mean	15.2	3.6	1.2		1.4	4.3
"8"	65.0	13.3	8.8	-0.7		0.5	-6.2
"9"		13.6	-15.9	-0.4		0.2	6.4
"10"		17.3	3.2	3.3		10.9	10.6
"11"		15.4	8.6	1.4		2.0	12.0
"12"		13.8	-1.5	-0.2		0	0.3
"13"		14.0	-28.6	0		0	-0
"14"		13.1	-7.4	-0.9		0.8	6.7
"15"		15.9	0.6	1.9		3.6	1.1
"16"		15.7	-12.4	1.7		2.9	-21.1
"17"		14.3	6.0	0.3		0.1	1.8
"18"		9.9	-18.2	-4.1		16.8	74.6
"19"		16.9	8.0	2.9		8.4	23.2
"20"		15.2	1.1	1.2		1.4	1.3
"21"		11.2	2.4	-2.8		7.8	-6.7
"22"		13.3	2.4	-0.7		0.5	-1.7
"23"		11.1	25.0	-2.9		8.4	-72.5
"24"		14.2	4.0	0.2		0	0.8
"25"		11.4	3.0	-2.6		6.8	-7.8
"26"		12.6	-6.0	-1.4		2.0	8.4
"27"		11.3	-3.0	-2.7		7.3	8.1
"28"		14.5	-19.0	0.5		0.3	-9.5

Correlation of Intelligence and Accuracy of Movement Cont.

GROUP 3

Subject	Intell-igence.	Acc. of Movement	x	y	x^2	y^2	xy
"29"		13.0	-10.0	-1.0		1.0	10.0
"30"		13.7	21.5	-0.3		0.1	-6.4
"31"		13.5	13.1	-0.5		0.3	-6.6
"32"		13.5	-5.4	-0.5		0.3	2.7
		Average				Σy^2=	Σxy=19.3
		13.5				102.6	corrected
		Prov.Mean				corrected	8.9
		14.0				94.6	

Correlation Coefficient of Intelligence and Accuracy of Movement (r)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{8.9}{\sqrt{4388.9 \times 94.6}}$$

$$= \frac{8.9}{645} = \underline{0.014}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n = no. of subjects

$$= \frac{1 - (.014)^2}{\sqrt{32}}$$

$$= \frac{1.0}{5.66}$$

$$= \underline{0.177}$$

Probable error of r = 0.674 × 0.177

$$= \underline{0.119}$$

Correlation of Spatial Percept. and Accuracy of Movement.

GROUP 3

Subject	Spatial Percept.	Acc. of Movement	x	y	x^2	y^2	xy
"1"	7.6	15.3	0.6	1.3	0.4	1.7	0.8
"2"	8.5	12.6	1.5	-1.4	2.3	2.0	-2.1
"3"	5.3	11.5	-1.7	-2.6	2.9	6.3	4.25
"4"	etc.	etc.	-0.3	-1.1	x^2 =	y^2 =	0.3
"5"	Average	Average	-2.4	-2.7	183.7	102.6	6.5
"6"	6.8	13.5	3.3	-0.5	corrected	corrected	-1.7
"7"	Prov.Mean	Prov. Mean	2.2	1.2	182.4	94.6	2.6
"8"	7.0	14.0	-1.9	-0.7			1.3
"9"			-3.2	-0.4			1.3
"10"			2.3	3.3			7.6
"11"			-0.9	1.4			-1.3
"12"			1.0	-0.2			-0.2
"13"			-2.9	0			0
"14"			-3.5	-0.9			3.2
"15"			0.6	1.9			1.1
"16"			0.9	1.7			1.5
"17"			4.2	0.3			1.3
"18"			-0.9	-4.1			3.7
"19"			0.2	2.9			0.6
"20"			-3.2	1.2			-3.8
"21"			-3.6	-2.8			10.1
"22"			0.4	-0.7			-0.3
"23"			4.5	-2.9			-13.1
"24"			-1.0	0.2			-0.2
"25"			-1.3	-2.6			3.4
"26"			1.3	-1.4			-1.8
"27"			-4.1	-2.7			11.1
"28"			-1.1	0.5			-0.6

Correlation of Spatial Percept. and Accuracy of Movement (Cont.)

GROUP 3

Subject	Spatial Percept.	Acc. of Movement	x	y	x^2	y^2	xy
"29"			-1.2	-1.0			1.2
"30"			4.2	-0.3			-1.3
"31"			-2.4	-0.5			1.2
"32"			2.1	-0.5			-1.1
							$\Sigma xy =$
							35.6
							corrected
							32.4

Correlation Coefficient of Spatial Perception and Accuracy of Movement. (r)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{32.4}{\sqrt{182.4 \times 94.6}}$$

$$= \frac{32.4}{131.2} = 0.246$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n = no of subject

$$= \frac{1 - (.246)^2}{\sqrt{32}}$$

$$= \frac{1 - .06}{5.66}$$

$$= \frac{.94}{5.66}$$

$$= 0.166$$

Probable error of r $= 0.674 \times 0.166$

$$= 0.112$$

Correlation of Intelligence and Eng. Ability Groups 1&2 together

(37 subjects in all)

Subject	Intelligence	Eng. Ability	x	y	x^2	y^2	xy
"I"	82.0	8.5	22.0	2.5	484.0	6.3	33.0
"II"	72.5	6.4	12.5	0.4	156.3	0.2	5.0
"III"	53.8	2.4	-6.2	-3.6	38.4	13.0	22.2
"IV"	60.0	5.4	0	-0.6	0	0.4	0
"V"	85.3	6.5	25.3	0.5	640.1	0.3	12.2
"VI"	86.2	8.0	26.2	2.0	686.4	4.0	52.4
"VII"	71.0	8.6	11.0	2.6	121.0	6.8	28.6
"VIII"	85.0	5.9	25.0	-0.1	625.0	0.01	-2.5
"IX"	41.2	5.5	-18.8	-0.5	353.4	0.3	9.4
"X"	81.6	8.7	21.6	2.7	466.6	7.3	58.2
"XI"	77.0	7.0	17.0	1.0	289.0	1.0	17.0
"XII"	65.0	2.3	5.0	-3.7	25.0	13.7	-18.5
"XIII"	66.6	7.4	6.6	1.4	43.6	2.0	9.3
"XIV"	57.0	8.4	-3.0	2.4	9.0	5.8	-7.2
"XV"	62.5	5.0	2.5	-1.0	6.3	1.0	-2.5
"XVI"	58.0	7.8	-2.0	1.8	4.0	3.2	-3.6
"XVII"	70.5	6.9	10.5	0.9	110.3	0.8	9.5
"XVIII"	83.0	7.9	23.0	1.9	529.0	3.6	43.7
"XIX"	55.5	7.6	-4.5	1.6	20.3	2.6	-7.2
"XX"	73.1	8.3	13.1	2.3	171.6	5.3	30.2
"XXI"	75.0	8.9	15.0	2.9	225.0	8.4	43.5
"XXII"	56.2	6.7	-3.8	0.7	14.4	0.5	-2.7
"XXIII"	67.2	7.6	7.2	1.6	51.8	2.6	11.5
"XXIV"	54.1	6.7	-5.9	0.7	34.8	0.5	-4.1
"XXV"	52.0	6.8	-8.0	0.8	64.0	0.6	-6.4
"XXVI"	53.6	6.4	-6.4	0.4	41.0	0.2	-2.6
"XXVII"	78.0	6.7	18.0	0.7	324.0	0.5	12.6
"A"	45.2	5.0	-14.8	-1.0	219.0	1.0	14.8
"B"	39.5	7.0	-20.5	1.0	420.3	1.0	-20.5
"C"	65.1	7.5	5.1	1.5	26.0	2.3	7.7

Correlation of Intelligence and Eng. Ability Groups 1 & 2 together (cont.)

(57 subjects in all)

Subject	Intelligence.	Eng. Ability	x	y	x^2	y^2	xy
"D"	26.7	5.0	-33.3	-1.0	1109.0	1.0	33.3
"E"	54.2	4.5	-5.8	-1.5	33.6	2.3	8.7
"F"	47.0	4.9	-13.0	-1.1	169.0	1.2	14.3
"G"	40.3	5.8	-19.3	-0.2	372.5	0.04	3.9
"H"	66.1	4.9	6.1	-1.1	37.2	1.2	-6.7
"I"	49.2	6.8	-10.8	0.8	116.6	0.6	-8.6
"J"	54.0	5.5	-6.0	-0.5	36.0	0.3	3.0
"K"	55.2	4.5	-4.8	-1.5	23.0	2.3	7.2
"L"	44.0	4.8	-16.0	-1.2	256.0	1.4	19.2
"M"	53.1	4.0	-6.9	-2.0	47.6	4.0	13.8
"N"	51.2	4.2	-8.8	-1.8	77.4	3.2	15.9
"O"	73.5	9.0	13.5	3.0	182.3	9.0	40.5
"P"	46.8	7.0	-13.2	1.0	174.2	1.0	-13.2
"Q"	53.0	7.1	-7.0	1.1	49.0	1.2	-7.7
"R"	66.8	6.1	6.8	0.1	47.6	0	0.7
"S"	89.0	8.5	29.0	2.5	841.0	6.3	72.5
"T"	34.0	5.3	-26.0	-0.7	676.0	0.5	18.2
"U"	37.0	8.6	-23.0	2.6	529.0	6.8	-59.8
"V"	59.3	5.3	-0.7	-0.7	0.5	0.5	0.5
"W"	54.7	5.1	-5.3	-0.9	28.1	0.8	4.8
"X"	54.2	5.4	-5.8	-0.6	33.6	0.4	3.5
"Y"	54.2	5.7	-5.8	-0.3	33.6	0.1	1.7
"Z"	37.0	7.2	-23.0	1.2	529.0	1.4	-27.6
"a"	67.8	6.8	7.8	0.8	60.8	0.6	6.2
"b"	13.0	4.0	-46.8	-2.0	2304.0	4.0	96.0
"c"	56.2	7.8	-3.8	1.8	14.4	3.2	-6.8
"d"	64.5	8.2	4.5	2.2	20.3	4.8	9.9
	Average	Average			Σx^2 =	Σy^2 =	Σxy =
	59.59	6.41			14000.9	153.3	586.4
	prov.mean	prov.mean			corrected	corrected	corrected
	6.0	6.0			13992.0	144.2	595.2

Correlation Coefficient of Intelligence and Eng. Ability Groups 1 & 2 together. (57 subjects in all)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{595.2}{\sqrt{13992 \times 144}}$$

$$= \frac{595.2}{118.3 \times 12.0}$$

$$= \underline{0.419}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - r^2}{\sqrt{57}}$$

$$= \frac{1 - (0.419)^2}{7.55}$$

$$= \frac{1 - 0.178}{7.55}$$

$$= \frac{0.822}{7.55}$$

$$= \underline{0.109}$$

Probable error of r $= 0.674 \times 0.109$

$$= \underline{0.073}$$

Correlation of Intelligence and Spatial Perception Groups 1 & 2 together.

(57 subjects in all)

Subject	Intelligence	Spatial Percept.	x	y	x^2	y^2	xy
"I"	82.0	7.6	22.0	0.6	484.0	0.4	13.2
"II"	72.5	7.6	12.5	0.6	156.3	0.4	7.5
"III"	53.8	3.0	-6.2	-4.0	38.4	16.0	24.8
"IV"	etc.	8.3	0	1.3	etc.	1.7	0
"V"	average	9.0	25.3	2.0	Σx^2 =	4.0	50.6
"VI"	59.59	13.0	26.2	6.0	14000.9	36.0	157.2
"VII"	prov.mean	9.0	11.0	2.0	corrected	4.0	22.0
"VIII"	80.0	9.8	25.0	2.8	13992.0	7.8	70.0
"IX"		5.6	-18.8	-1.4		2.0	26.3
"X"		11.6	21.6	4.6		21.2	99.2
"XI"		8.1	17.0	1.1		1.2	18.7
"XII"		3.7	[illegible].0	-3.3		10.9	-16.5
"XIII"		9.0	6.6	2.0		4.0	13.2
"XIV"		9.8	-3.0	2.8		7.8	-8.4
"XV"		6.4	2.5	-0.6		0.4	-1.5
"XVI"		9.6	-2.0	2.6		6.8	-5.2
"XVII"		6.6	10.5	-0.4		0.2	-4.2
"XVIII"		9.7	23.0	2.7		7.3	62.1
"XIX"		6.6	-4.5	-0.4		0.2	1.8
"XX"		6.5	13.1	-0.5		0.3	-6.6
"XXI"		9.7	15.0	2.7		7.3	40.5
"XXII"		5.3	-3.8	-1.7		2.9	6.5
"XXIII"		8.3	7.2	1.3		1.7	9.4
"XXIV"		5.7	-5.9	-1.3		1.7	7.7
"XXV"		6.0	-8.0	-1.0		1.0	8.0
"XXVI"		5.9	-6.4	-1.1		1.2	7.0
"XXVII"		12.2	18.0	5.2		27.0	93.6
"A"		2.3	-14.8	-4.7		22.1	69.6
"B"		3.8	-20.5	-3.2		10.2	65.6
"C"		7.1	5.1	0.1		0	0.5

Correlation of Intelligence and Spatial Perception Groups 1 & 2 together. (Cont.)

(57 subjects in all)

Subject	Intelligence.	Spatial Percept.	x	y	x^2	y^2	xy
"D"		3.7	-33.3	-3.3		10.9	110.0
"E"		6.2	-5.8	-0.8		0.6	4.6
"F"		4.1	-13.0	-2.9		8.4	37.7
"G"		7.0	-19.3	0		0	0
"H"		5.5	6.1	-1.5		2.3	-9.2
"I"		8.6	-10.8	1.6		2.6	-17.3
"J"		4.3	-6.0	-2.7		7.3	16.2
"K"		5.5	-4.8	-1.5		2.3	7.2
"L"		7.2	-16.0	0.2		0	-3.2
"M"		4.6	-6.9	-2.4		5.8	16.6
"N"		4.2	-8.8	-2.8		7.8	24.6
"O"		6.8	13.5	-0.2		0	-2.7
"P"		9.6	-13.2	2.6		6.8	-34.4
"Q"		7.0	-7.0	0		0	0
"R"		5.9	6.8	-1.1		1.2	-7.4
"S"		12.8	29.0	5.8		33.6	168.1
"T"		4.3	-26.0	-2.7		7.3	70.1
"U"		31	-23.0	-3.9		15.2	89.6
"V"		4.2	-0.7	-2.8		7.8	2.0
"W"		6.4	-5.3	-0.6		0.4	3.2
"X"		5.2	-5.8	-1.8		3.2	10.4
"Y"		5.5	-5.8	-1.5		2.3	8.7
"Z"		5.8	-23.0	-1.2		1.4	27.6
"a"		6.7	7.8	-0.3		0.1	-2.3
"b"		6.8	-4.8	-0.2		0	9.6
"c"		6.1	-5.8	-0.9		0.8	3.4
"d"		11.4	4.5	4.4		19.4	19.8
		Average				Σy^2 =	Σxy =
		6.935				355.2	1385.5
		prov.mean				corrected	corrected
		7.0				315.0	1370.7

Correlation Coefficient of Intelligence and Spatial Perception

Groups 0 & 2 together. (57 subjects in all)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{1370.7}{\sqrt{13992 \times 355}}$$

$$= \frac{1370.7}{118.3 \times 18.84}$$

$$= \underline{0.63}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.63)^2}{\sqrt{57}}$$

$$= \frac{1 - 0.3969}{7.55}$$

$$= \frac{0.6031}{7.55}$$

$$= \underline{0.08}$$

Probable error of $r = 0.674 \times 0.08$

$$= \underline{0.054}$$

Correlation of Intelligence and Accuracy of Movement Groups 1 & 2 together.

(57 subjects in all)

Subject	Intelligence.	Acc. of Movement	x	y	x^2	y^2	xy
"I"	82.0	13.8	22.0	-0.2	484.0	0	-4.4
"II"	72.5	16.6	12.5	2.6	156.3	6.8	32.5
"III"	53,8	13.5	-6.2	-0.5	38.4	0.3	3.1
"IV"	etc.	14.2	0	0.2	etc.	0	0
"V"	average	13.8	25.3	-0.2	Σx^2 =	0	-5.1
"VI"	59.59	20.2	26.2	6.2	14000.9	38.4	162.5
"VII"	prov.mean	18.6	11.0	4.6	corrected	21.2	50.6
"VIII"	60.0	11.5	25.0	-2.5	13992.0	6.3	-62.5
"IX"		11.1	-13.8	-2.9		8.4	54.5
"X"		20.7	21.6	6.7		44.9	145.0
"XI"		13.6	17.0	-0.4		0.2	-6.8
"XII"		12.5	5.0	-1.5		2.3	-7.5
"XIII"		13.9	6.6	-0.1		0	-0.7
"XIV"		18.4	-3.0	4.4		19.4	-13.2
"XV"		12.2	2.5	-1.8		3.2	-4.5
"XVI"		17.6	-2.0	3.6		13.0	-7.2
"XVII"		14.6	10.5	0.6		0.4	6.3
"XVIII"		14.3	23.0	0.3		0.1	6.9
"XIX"		14.1	-1.5	0.1		0	-0.5
"XX"		13.1	13.1	-0.9		0.8	-11.8
"XXI"		19.5	15.0	5.5		30.3	82.5
"XXII"		11.6	-3.8	-2.4		5.8	9.1
"XXIII"		12.5	7.2	-1.5		2.3	-10.8
"XXIV"		15.5	-5.9	1.5		2.3	-8.8
"XXV"		12.7	-8.0	-1.3		1.7	10.4
"XXVI"		13.8	-6.4	-0.2		0	1.3
"XXVII"		17.7	18.0	3.7		13.7	66.6
"A"		11.4	-14.8	-2.6		6.8	38.4
"B"		12.7	-20.5	-1.3		1.7	26.6
"C"		8.0	5.1	-6.0		36.0	-30.6

Correlation of Intelligence and Accuracy of Movement Groups 1 &2 together (Cont.)

(37 subjects in all)

Subject	Intell-igence.	Acc. of Movement.	x	y	x^2	y^2	xy
"D"		9.5	-33.3	-4.5		20.3	150.0
"E"		11.9	-5.8	-2.1		4.4	12.2
"F"		15.5	-13.0	1.5		2.3	-19.5
"G"		15.5	-19.3	1.5		2.3	-28.9
"H"		13.0	6.1	-1.0		1.0	-6.1
"I"		14.3	-10.8	0.3		0.1	-3.2
"J"		10.3	-6.0	-3.7		13.7	22.2
"K"		12.9	-4.8	-1.1		1.2	5.3
"L"		19.5	-16.0	5.5		30.3	-88.0
"M"		11.2	-6.9	-2.8		7.8	19.3
"N"		11.2	-8.8	-2.8		7.8	24.6
"O"		11.4	13.5	-2.6		6.8	-35.1
"P"		15.5	-13.2	1.5		2.3	-19.8
"Q"		11.5	-7.0	-2.5		6.3	17.5
"R"		11.6	6.8	-2.4		5.8	-16.3
"S"		24.0	29.0	10.0		100.0	290.0
"T"		13.7	-26.0	-0.3		0.1	7.8
"U"		9.6	-23.0	-4.2		17.6	96.5
"V"		13.4	-0.7	-0.6		0.4	0.4
"W"		20.0	-5.3	6.0		36.0	-31.8
"X"		13.8	-5.8	-1.2		1.4	7.0
"Y"		14.6	-5.8	0.8		0.4	-3.5
"Z"		11.8	-23.0	-2.2		4.8	50.6
"a"		17.8	7.8	3.8		14.4	29.6
"b"		11.2	-48.0	-2.8		7.8	134.5
"c"		16.5	-3.8	2.5		6.3	-9.5
"d"		12.9	4.5	-1.1		1.2	-5.0
		average				Σy^2 =	Σxy =
		14.2				569.1	1123.0
		prov.mean				corrected	corrected
		14.0				566.8	1127.6

Correlation Coefficient of Intelligence and Accuracy of Movement

Groups 1 & 2 together. (57 subjects in all)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{1127.6}{\sqrt{13992.0 \times 566.8}}$$

$$= \frac{1127.6}{118.3 \times 23.8}$$

$$= \underline{0.40}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.4)^2}{\sqrt{57}}$$

$$= \frac{1 - 0.16}{7.55}$$

$$= \frac{0.84}{7.55}$$

$$= \underline{0.1112}$$

Probable error of r $= 0.674 \times 0.1112$

$$= \underline{0.075}$$

Correlation of Eng. Ability and Spatial Perception Groups 1 & 2 together.

(57 subjects in all.)

Subject	Eng. Ability	Spatial Percept.	x	y	x^2	y^2	xy
"I"	8.5	7.6	2.5	0.6	6.3	0.4	1.5
"II"	6.4	7.6	0.4	0.6	0.2	0.4	0.2
"III"	2.4	3.0	-3.6	-4.0	13.0	16.0	14.4
"IV"	etc.	etc.	-0.6	1.3	etc.	etc.	-0.8
"V"	average	average	0.5	2.0	Σx^2 =	Σy^2 =	11.0
"VI"	6.41	6.935	2.0	6.0	153.3	355.2	12.0
"VII"	prov.mean	say	3.6	2.0	corrected	corrected	5.2
"VIII"	6.0	7.0	-0.1	2.8	144.2	355.0	-0.3
"IX"			-0.5	-1.4			0.7
"X"			2.7	4.6			12.4
"XI"			1.0	1.1			1.1
"XII"			-3.7	-3.3			12.2
"XIII"			1.4	2.0			2.8
"XIV"			2.4	2.8			6.7
"XV"			-1.0	-0.6			0.6
"XVI"			1.8	2.6			4.7
"XVII"			0.9	-0.4			-0.4
"XVIII"			1.9	2.7			5.1
"XIX"			1.6	-0.4			-0.6
"XX"			2.3	-0.5			-1.2
"XXI"			2.9	2.7			7.8
"XXII"			0.7	-1.7			-1.2
"XXIII"			1.6	1.3			2.1
"XXIV"			0.7	-1.3			-0.9
"XXV"			0.8	-1.0			-0.8
"XXVI"			0.4	-1.1			-0.4
"XXVII"			0.7	5.2			3.6
"A"			-1.0	-4.7			4.7
"B"			1.0	-3.2			-3.2
"C"			1.5	0.1			0.2

Correlation of Eng. Ability and Spatial Perception Groups 1 & 2 together (Cont.)

(57 subjects in all)

Subject	Eng. Ability	Spatial Percept.	x	y	x^2	y^2	xy
"D"			-0.1	-3.3			3.3
"E"			-1.5	-0.8			1.2
"F"			-1.1	-2.9			3.2
"G"			-0.2	0			0
"H"			-1.1	-1.5			1.7
"I"			0.8	1.6			1.3
"J"			-0.5	-2.7			1.4
"K"			-1.5	-1.5			2.3
"L"			-1.2	0.2			-0.2
"M"			-2.0	-2.4			4.8
"N"			-1.8	-2.8			5.0
"O"			3.0	-0.2			-0.6
"P"			1.0	2.6			2.6
"Q"			1.1	0			0
"R"			0.1	-1.1			-0.1
"S"			2.5	5.8			14.5
"T"			-0.7	-2.7			1.9
"U"			2.6	-3.9			-10.1
"V"			-0.7	-2.8			2.0
"W"			-0.9	-0.6			0.5
"X"			-0.6	-1.8			1.3
"Y"			-0.3	-1.5			0.5
"Z"			1.2	-1.2			-1.4
"a"			0.8	-0.3			-0.2
"b"			-2.0	-0.2			0.4
"c"			1.8	-0.9			-1.6
"d"			2.2	4.4			9.7
							Σxy = 132.6
							corrected 134.1

Correlation coefficient of Eng. Ability and Spatial Perception

Groups 1 & 2 together. (57 subjects in all.)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{134.1}{\sqrt{144.2 \times 355.0}}$$

$$= \frac{134.1}{12.0 \times 18.84}$$

$$= \underline{0.593}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.593)^2}{\sqrt{57}}$$

$$= \frac{1 - 0.352}{7.55}$$

$$= \frac{0.648}{7.55}$$

$$= \underline{0.0858}$$

Probable error of r $= 0.674 \times 0.0858$

$$= \underline{0.0578}$$

Correlation of Eng. Ability and Acc. of Movement Groups 1 & 2 together.

(57 subjects in all)

Subject	Eng. Ability	Acc. of Movement	x	y	x^2	y^2	xy
"I"	8.5	13.8	2.5	-0.2	6.3	0	-0.5
"II"	6.4	13.6	0.4	2.6	0.2	6.8	1.0
"III"	2.4	13.5	-3.6	-0.5	13.0	0.3	1.8
"IV"	etc.	etc.	-0.6	0.2	etc.	etc.	-0.1
"V"	average	average	0.5	-0.2	Σx^2 =	Σy^2 =	-0.1
"VI"	6.41	14.175	2.0	6.2	153.3	569.1	12.4
"VII"	prov.mean	prov.mean	2.6	4.6	corrected	corrected	12.0
"VIII"	6.0	14.0	-0.1	-2.5	144.2	566.8	0.3
"IX"			-0.5	-2.9			1.5
"X"			2.7	6.7			18.1
"XI"			1.0	-0.4			-0.4
"XII"			-3.7	-1.5			5.6
"XIII"			1.4	-0.1			-0.1
"XIV"			2.4	4.4			10.6
"XV"			-1.0	-1.8			1.8
"XVI"			1.8	3.6			6.5
"XVII"			0.9	0.6			0.5
"XVIII"			1.9	0.3			0.6
"XIX"			1.6	0.1			0.2
"XX"			2.3	-0.9			-2.1
"XXI"			2.9	5.5			16.0
"XXII"			0.7	-2.4			-1.7
"XXIII"			1.6	-1.5			-2.4
"XXIV"			0.7	1.5			1.1
"XXV"			0.8	-1.3			-1.0
"XXVI"			0.4	-0.2			-0.1
"XXVII"			0.7	3.7			2.6
"A"			-1.0	-2.6			2.6
"B"			1.0	-1.3			-1.3
"C"			1.5	-3.0			-3.0

Correlation of Eng. Ability and Acc. of Movement Groups 1 & 2 together (Cont.)

(57 subjects in all)

Subject	Eng. Ability	Acc. of Movement	x	y	x^2	y^2	xy
"D"			-1.0	-4.6			4.6
"E"			-1.5	-2.1			3.2
"F"			-1.1	1.6			-1.7
"G"			-0.2	1.6			-0.3
"H"			-1.1	-1.0			1.1
"I"			0.8	0.3			0.2
"J"			-0.5	-3.7			1.9
"K"			-1.5	-1.1			1.7
"L"			-1.2	5.5			-6.6
"M"			-2.0	-2.8			5.6
"N"			-1.8	-2.8			5.1
"O"			3.0	-2.6			-7.8
"P"			1.0	1.5			1.5
"Q"			1.1	-2.5			-2.8
"R"			0.1	-2.4			-0.2
"S"			2.5	10.0			25.0
"T"			-0.7	-0.3			0.2
"U"			2.6	-4.2			-10.9
"V"			-0.7	-0.6			0.4
"W"			-0.9	6.0			-5.4
"X"			-0.6	-1.2			0.7
"Y"			-0.3	0.6			-0.2
"Z"			1.2	-2.2			-2.6
"a"			0.8	3.8			3.0
"b"			-2.0	-2.8			5.6
"c"			1.8	2.5			4.5
"d"			2.2	-1.1			-2.4
							Σxy = 99.7
							corrected 95.14

Correlation Coefficient of Eng. Ability and Acc. of Movement

Groups 1 & 2 together. 87 subjects in all.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{92.14}{\sqrt{144.2 \times 566.8}}$$

$$= \frac{92.14}{12.0 \times 23.8}$$

$$= \underline{0.333}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.333)^2}{\sqrt{87}}$$

$$= \frac{1 - 0.111}{7.68}$$

$$= \frac{0.889}{7.68}$$

$$= \underline{0.1175}$$

Probable error of r $= 0.674 \times 0.1175$

$$= \underline{0.0791}$$

Correlation of Spatial Perception and Acc. of Movement. Groups 1 & 2 together.

(57 subjects in all)

Subject	Spatial Percept.	Acc. of Movement	x	y	x^2	y^2	xy
"I"	7.6	13.8	0.6	-0.2	0.4	0	-0.1
"II"	7.6	16.6	0.6	2.6	0.4	6.8	1.6
"III"	3.0	13.5	-4.0	-0.5	16.0	0.3	2.0
"IV"	etc.	etc.	1.3	0.2	etc.	etc.	0.3
"V"	average	average	2.0	-0.2	Σx^2 =	Σy^2 =	-0.4
"VI"	6.935	14.175	0.0	6.2	385.2	569.1	37.2
"VII"	prov.mean	prov.mean	2.0	4.6	corrected	corrected	9.2
"VIII"	7.0	14.0	2.8	-2.5	355.0	566.8	-7.0
"IX"			-1.4	-2.9			4.1
"X"			1.6	6.7			30.8
"XI"			1.1	-0.4			- 0.4
"XII"			-3.3	-1.5			5.0
"XIII"			2.0	-0.1			-0.2
"XIV"			2.8	4.4			-12.6
"XV"			-0.6	-1.8			1.1
"XVI"			2.6	3.6			9.4
"XVII"			-0.4	0.6			-0.2
"XVIII"			2.7	0.3			0.8
"XIX"			-0.4	0.1			0
"XX"			-0.5	-0.9			0.5
"XXI"			2.7	5.5			14.9
"XXII"			-1.7	-2.4			4.1
"XXIII"			1.3	-1.5			-1.9
"XXIV"			-1.3	1.5			-2.0
"XXV"			-1.0	-1.3			1.3
"XXVI"			-1.1	-0.2			0.2
"XXVII"			5.2	3.7			19.3
"A"			-4.7	-2.6			12.2
"B"			-3.2	-1.3			4.2
"C"			0.1	-6.0			-0.6

Correlation of Spatial Perception and Acc. of Movement. Groups 1 & 2 together (Cont.)

(57 subjects in all)

Subject	Spatial Percept.	Acc. of Movement	x	y	x^2	y^2	xy
"D"			-3.3	-4.5			14.9
"E"			-0.8	-2.1			1.7
"F"			-2.9	1.5			-4.4
"G"			0	1.5			0
"H"			-1.5	-1.0			1.5
"I"			1.6	0.3			0.5
"J"			-2.7	-3.7			10.0
"K"			-1.5	-1.1			1.7
"L"			0.2	5.5			1.1
"M"			-2.4	-2.8			6.7
"N"			-2.8	-2.8			7.8
"O"			-0.2	-2.6			0.5
"P"			2.6	1.5			3.9
"Q"			0	-2.5			0
"R"			-1.1	-2.4			2.6
"S"			5.8	10.0			58.0
"T"			-2.7	-0.3			0.8
"U"			-3.9	-4.2			16.4
"V"			-2.8	-0.6			1.7
"W"			-0.6	6.0			-3.6
"X"			-1.8	-1.2			2.2
"Y"			-1.5	0.6			-0.9
"Z"			-1.2	-2.2			2.6
"a"			-0.3	3.8			-1.1
"b"			-0.2	-2.8			0.6
"c"			-0.9	2.5			-2.3
"d"			4.4	-1.1			-4.8
"e"							Σxy = 276.1
							corrected 276.8

Correlation Coefficient of Spatial Perception and Acc. of Movement. Groups 1 & 2 together. (57 subjects in all).

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{276.8}{\sqrt{355.0 \times 566.8}}$$

$$= \frac{276.8}{18.84 \times 23.8}$$

$$= \underline{0.633}$$

Standard error of $r = \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.633)^2}{\sqrt{57}}$$

$$= \frac{1 - 0.4007}{7.55}$$

$$= \frac{0.5993}{7.55}$$

$$= \underline{0.0794}$$

Probable error of $r = 0.674 \times 0.0794$

$$= \underline{0.0535}$$

Correlation of Intelligence and Spatial Perception for all subjects.

Subject	Intelligence	Spatial Percept.	x	y	x^2	y^2	xy
"I"	82.0	7.6	22.0	0.6	484.0	0.4	13.2
"II"	72.5	7.6	12.5	0.6	156.3	0.4	7.5
"III"	53.8	3.0	-6.2	-4.0	38.4	16.0	24.8
"IV"	60.0	8.3	0	1.3	0	1.7	0
"V"	85.3	9.0	25.3	2.0	640.1	4.0	50.6
"VI"	86.2	13.0	26.2	6.0	686.4	36.0	157.2
"VII"	71.0	9.0	11.0	2.0	121.0	4.0	22.0
"VIII"	85.0	9.8	25.0	2.8	625.0	7.8	70.0
"IX"	41.2	5.6	-18.8	-1.4	353.4	2.0	26.3
"X"	81.6	11.6	21.6	4.6	466.6	21.2	96.6
"XI"	77.0	8.1	17.0	1.1	289.0	1.2	18.7
"XII"	65.0	3.7	5.0	-3.3	25.0	10.9	-16.5
"XIII"	66.6	9.0	6.6	2.0	43.6	4.0	13.2
"XIV"	57.0	9.8	-3.0	2.8	9.0	7.8	-8.4
"XV"	62.5	6.4	2.5	-0.6	6.3	0.4	-15.0
"XVI"	58.0	9.6	-2.0	2.6	4.0	6.8	-5.2
"XVII"	70.5	6.6	10.5	-0.4	110.3	0.2	-4.2
"XVIII"	83.0	9.7	23.0	2.7	529.0	7.3	62.1
"XIX"	55.5	6.6	-4.5	-0.4	20.3	0.2	1.8
"XX"	73.1	6.5	13.1	-0.5	171.6	0.3	-6.6
"XXI"	75.0	9.7	15.0	2.7	225.0	7.3	40.5
"XXII"	56.0	5.3	-3.8	-1.7	14.4	2.9	6.5
"XXIII"	67.2	8.3	7.2	1.3	51.8	1.7	9.4
"XXIV"	54.1	5.7	-5.9	-1.3	34.8	1.7	7.7
"XXV"	52.0	6.0	-8.0	-1.0	64.0	1.0	8.0
"XXVI"	53.6	5.9	-6.4	-1.1	41.0	1.2	7.0
"XXVII"	78.0	12.2	18.0	5.2	324.0	27.0	93.6
"A"	45.3	2.3	-14.8	-4.7	219.0	22.1	69.5
"B"	39.5	3.8	-20.5	-3.2	420.3	10.2	65.5
"C"	65.1	7.1	5.1	0.1	26.0	0	0.5
"D"	26.7	3.8	-33.3	-3.3	1109.0	10.9	110.0

Correlation of Intelligence and Spatial Perception for all subjects (Cont.)

Subject	Intell-igence	Spatial Percept.	x	y	x^2	y^2	xy
"E"	54.2	6.2	-5.8	-0.8	33.6	0.6	4.6
"F"	47.0	4.1	-13.0	-2.9	169.0	8.4	37.7
"G"	43.0	7.0	-19.3	0	372.5	0	0
"H"	66.1	5.5	6.1	-1.5	37.2	2.3	-9.2
"I"	49.2	8.6	-10.8	1.6	116.6	2.6	-17.3
"J"	54.0	4.3	-6.0	-2.7	36.0	7.3	16.2
"K"	55.2	5.5	-4.8	-1.5	23.0	2.3	7.2
"L"	44.0	7.2	-16.0	0.2	256.0	0	-3.2
"M"	53.1	4.6	-6.9	-2.4	47.6	5.8	16.6
"N"	51.2	4.2	-8.8	-2.8	77.4	7.8	24.6
"O"	73.5	6.8	13.5	-0.2	182.3	0	-2.7
"P"	46.8	9.6	-13.2	2.6	174.2	6.8	-34.4
"Q"	53.0	7.0	-7.0	0	49.0	0	0
"R"	66.8	5.9	6.8	-1.1	47.6	1.2	-7.5
"S"	89.0	12.8	29.0	5.8	841.0	33.6	168.2
"T"	34.0	4.3	-26.0	-2.7	676.0	7.3	70.0
"U"	37.0	3.1	-23.0	-3.9	529.0	15.2	89.5
"V"	59.3	4.2	-0.7	-2.8	0.5	7.8	2.0
"W"	54.7	6.4	-5.3	-0.6	28.1	0.4	3.2
"X"	54.2	5.2	-5.8	-1.8	33.6	3.2	10.4
"Y"	54.2	5.5	-5.8	-1.5	33.6	2.3	31.9
"Z"	37.0	5.8	-23.0	-1.2	529.0	1.4	133.2
"a"	67.8	6.7	7.8	0.7	60.8	0.5	5.5
"b"	12.0	6.8	-4.8	-0.2	2304.0	0	9.6
"c"	56.2	6.1	-3.8	-0.9	14.4	0.8	3.4
"d"	64.5	11.4	4.5	4.4	20.3	19.4	19.8
"1"	69.0	7.6	9.0	0.6	81.0	0.4	5.4
"2"	58.0	8.5	-2.0	1.5	4.0	2.3	-3.0
"3"	55.5	5.3	-4.5	-1.7	20.3	2.9	7.7
"4"	70.5	6.7	10.5	-0.3	110.3	0.1	-3.2
"5"	84.5	4.6	24.5	-2.4	600.3	5.8	-58.8

Correlation of Intelligence and Spatial Perception for all subjects (Cont.)

Subject	Intell-igence	Spatial Percept.	x	y	x^2	y^2	xy
"6"	54.2	10.3	-5.8	3.3	33.6	10.9	-19.2
"7"	68.6	9.2	8.6	2.2	74.0	4.8	18.9
"8"	73.8	5.1	13.8	-1.9	190.4	3.6	-26.2
"9"	49.1	3.8	-10.9	-3.2	118.8	10.2	34.9
"10"	68.2	9.3	8.2	2.3	67.2	5.3	18.9
"11"	73.6	6.1	13.6	-0.9	185.0	0.8	-12.2
"12"	63.5	8.0	3.5	1.0	12.3	1.0	3.5
"13"	36.4	4.1	-23.6	-2.9	557.0	8.4	68.4
"14"	57.6	3.5	-2.4	-3.5	5.8	12.3	8.4
"15"	65.6	7.6	5.6	0.6	31.4	0.4	3.4
"16"	52.6	7.9	-7.4	0.9	54.8	0.8	-6.7
"17"	71.0	11.2	11.0	4.2	121.0	17.6	46.2
"18"	46.8	6.1	-13.2	-0.9	174.2	0.8	11.9
"19"	73.0	7.2	13.0	0.2	169.0	0	2.6
"20"	66.1	3.8	6.1	-3.2	37.2	10.2	-19.5
"21"	67.4	3.4	7.4	-3.6	54.8	13.0	-26.6
"22"	67.4	7.4	7.4	0.4	54.8	0.2	3.0
"23"	90.0	11.5	30.0	4.5	900.0	20.3	135.0
"24"	69.0	6.0	9.0	-1.0	81.0	1.0	-9.0
"25"	68.0	5.7	8.0	-1.3	64.0	1.7	-10.4
"26"	59.0	8.3	-1.0	1.3	1.0	1.7	-1.3
"27"	62.0	2.9	2.0	-4.1	4.0	16.8	-8.2
"28"	46.0	5.9	-14.0	-1.1	196.0	1.2	15.4
"29"	55.0	5.8	-5.0	-1.2	25.0	1.4	6.0
"30"	86.5	11.2	26.5	4.2	702.3	17.6	111.2
"31"	78.1	4.6	18.1	-2.4	327.6	5.8	-43.4
"32"	59.6	9.1	-0.4	2.1	0.2	4.4	-0.8
	average	average			Σx^2 =	Σy^2 =	Σxy =
	60.55	6.88			19059.2	539.3	1648.9
	prov.mean	prov.mean			corrected	corrected	corrected
	60.0	7.0			19032.5	538.1	1654.2

Correlation Coefficient of Intelligence and Spatial Perception

for all subjects. Groups 1.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{1654.2}{\sqrt{19032.5 \times 538.1}}$$

$$= \frac{1654.2}{138.0 \times 23.2}$$

$$= \underline{0.518}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.518)^2}{\sqrt{89}}$$

$$= \frac{1 - 0.268}{9.434}$$

$$= \frac{0.732}{9.43}$$

$$= \underline{0.077}$$

Probable error of r $= 0.674 \times 0.077$

$$= \underline{0.052}$$

Correlation of Intelligence and Acc. of Movement for all subjects.

Subject	Intell-igence	Acc. of Movement	x	y	x^2	y^2	xy
"I"	82.0	13.8	22.0	-0.2	484.0	0	-4.4
"II"	72.5	16.6	12.5	2.6	156.3	6.8	32.5
"III"	53.8	13.5	-6.2	-0.5	38.4	0.3	3.1
"IV"	average	14.2	0.	0.2	etc.	0	0
"V"	60.55	13.8	25.3	-0.2	Σx^2 =	0	-5.1
"VI"	prov.mean	20.2	26.2	6.2	19059.2	38.4	162.5
"VII"	60.0	18.6	11.0	4.6	corrected	21.2	50.6
"VIII"		11.5	25.0	-2.5	19032.5	6.3	-62.5
"IX"		11.1	-18.8	-2.9		8.4	54.5
"X"		20.7	21.6	6.7		44.9	144.9
"XI"		13.6	17.0	-0.4		0.2	-6.8
"XII"		12.5	5.0	-1.5		2.3	-7.5
"XIII"		13.9	6.6	-0.1		0	-0.7
"XIV"		18.4	-3.0	4.4		19.4	-13.2
"XV"		12.2	2.5	-1.8		3.2	-4.5
"XVI"		17.6	-2.0	3.6		13.0	-7.2
"XVII"		14.6	10.5	0.6		0.4	6.3
"XVIII"		14.3	23.0	0.3		0.1	6.9
"XIX"		14.1	-4.5	0.1		0	-0.4
"XX"		13.1	13.1	-0.9		0.8	-11.8
"XXI"		19.5	15.0	5.5		30.3	82.5
"XXII"		11.6	-3.8	-2.4		5.8	9.1
"XXIII"		12.5	7.2	-1.5		2.3	-10.8
"XXIV"		15.5	-5.9	1.5		2.3	-8.8
"XXV"		12.7	8.0	-1.3		1.7	-10.4
"XXVI"		13.8	-6.4	-0.2		0	1.3
"XXVII"		17.7	18.0	3.7		13.7	66.6
"A"		11.4	-14.8	-2.6		6.8	38.4
"B"		12.7	-20.5	-1.3		1.7	26.6
"C"		8.0	5.1	-6.0		36.0	-30.6
"D"		9.5	-33.3	-4.5		20.3	150.0

Correlation of Intelligence and Acc. of Movement. for all subjects (Cont.)

Subject	Intell-igence	Acc. of Movement	x	y	x^2	y^2	xy
"E"		11.9	-5.8	-2.1		4.4	12.4
"F"		15.5	-13.0	1.5		2.3	-19.5
"G"		15.5	-19.3	1.5		2.3	-29.0
"H"		13.0	6.1	-1.0		1.0	-6.1
"I"		14.3	-10.8	0.3		0.1	-3.2
"J"		10.3	-6.0	-3.7		13.8	22.2
"K"		12.9	-4.8	-1.1		1.2	5.3
"L"		19.5	-16.0	5.5		30.3	-88.0
"M"		11.2	-6.9	-2.8		7.8	19.3
"N"		11.2	-8.8	-2.8		7.8	24.6
"O"		11.4	13.5	-2.6		6.8	-35.1
"P"		15.5	-13.2	1.5		2.3	-19.8
"Q"		11.5	-7.0	-2.5		6.3	17.5
"R"		11.3	6.8	-2.4		5.8	-16.3
"S"		24.0	29.0	10.0		100.0	290.0
"T"		13.7	-26.0	-0.3		0.1	7.8
"U"		9.8	-23.0	-4.2		17.6	96.5
"V"		13.4	-0.7	-0.6		0.4	0.4
"W"		20.0	-5.3	6.0		36.0	-31.8
"X"		12.3	-5.8	-1.2		1.4	7.0
"Y"		14.3	-5.8	0.6		0.4	-3.5
"Z"		11.8	-23.0	-2.2		4.8	50.6
"a"		17.8	7.8	3.8		14.4	29.6
"b"		11.2	-48.0	-2.8		7.8	134.5
"c"		16.5	-3.0	2.5		6.3	-7.5
"d"		12.9	4.5	-1.1		1.2	-4.9
"1"		15.3	9.0	1.3		1.7	1.2
"2"		12.6	-2.0	-1.4		2.0	2.8
"3"		11.5	-4.5	-2.5		6.3	11.3
"4"		12.9	10.5	-1.1		1.2	-11.6
"5"		11.3	24.5	-2.7		7.3	-66.2

Correlation of Intelligence and Acc. of Movement for all subjects. (Cont.)

Subject	Intell-igence.	Acc. of Movement	x	y	x^2	y^2	xy
"6"		13.5	-5.8	-0.5		0.3	2.9
"7"		15.2	8.6	1.2		1.4	10.3
"8"		13.3	13.8	-0.7		0.5	-9.7
"9"		13.6	-10.9	+0.4		0.2	4.4
"10"		17.3	8.2	3.3		10.9	27.1
"11"		15.4	13.6	1.4		2.0	19.0
"12"		13.8	3.5	-0.2		0	-0.7
"13"		14.0	-23.6	0		0	0
"14"		13.1	-2.4	-0.9		0.8	2.2
"15"		15.9	5.6	1.9		3.6	10.6
"16"		15.7	-7.4	1.7		2.9	-12.6
"17"		14.3	11.0	0.3		0.1	3.3
"18"		9.9	-15.2	-4.1		16.8	54.1
"19"		16.9	13.0	2.9		8.4	37.7
"20"		15.2	6.1	1.2		1.4	7.3
"21"		11.2	7.4	-2.8		7.8	-20.7
"22"		13.3	7.4	-0.7		0.5	-5.2
"23"		11.1	30.0	-2.9		8.4	-87.0
"24"		14.2	9.0	0.2		0	1.8
"25"		11.4	8.0	-2.6		6.8	-20.8
"26"		12.6	-1.0	-1.4		2.0	1.4
"27"		11.3	2.0	-2.7		7.3	-5.4
"28"		14.5	-14.0	0.5		0.3	-7.0
"29"		13.0	-5.0	-1.0		1.0	5.0
"30"		13.7	26.5	-0.3		0.1	-8.0
"31"		13.5	18.1	-0.5		0.3	-9.1
"32"		13.5	-0.4	-0.5		0.3	0.2
		average				Σy^2 =	Σxy =
		13.83				671.7	1042.7
		prov.mean				corrected	corrected
		14.0				669.1	1050.7

Correlation Coefficient of Intelligence and Acc. of Movement for all subjects. (r).

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{1050.7}{\sqrt{19032.5 \times 669.1}}$$

$$= \frac{1050.7}{138.0 \times 25.87}$$

$$= \underline{0.294}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.294)^2}{\sqrt{89}}$$

$$= \frac{1 - 0.086}{9.434}$$

$$= \frac{0.914}{9.434}$$

$$= \underline{0.097}$$

Probable error of r $= 0.674 \times 0.097$

$$= \underline{0.065}$$

Correlation of Spatial Perception and Acc. of Movement for all subjects.

Subject	Spatial Percept.	Acc. of Movement	x	y	x^2	y^2	xy
"I"	7.6	13.8	0.6	-0.2	0.4	0	-0.1
"II"	7.6	16.6	0.6	2.6	0.4	6.8	1.6
"III"	3.0	13.5	-4.0	-0.5	16.0	0.3	2.0
"IV"	etc.	etc.	1.3	0.2	etc.	etc.	0.3
"V"	average	average	2.0	-0.2	Σx^2 =	Σy^2 =	-0.4
"VI"	6.88	13.85	6.0	6.2	539.3	671.7	37.2
"VII"	prov.mean	prov.mean	2.0	4.6	corrected	corrected	9.2
"VIII"	7.0	14.0	2.8	-2.5	538.1	669.1	-7.0
"IX"			-1.4	-2.9			4.1
"X"			4.6	6.7			30.8
"XI"			1.1	-0.4			-0.4
"XII"			-3.3	-1.5			5.0
"XIII"			2.0	-0.1			-0.2
"XIV"			2.8	4.4			12.3
"XV"			-0.6	-1.8			1.1
"XVI"			2.6	3.6			9.4
"XVII"			-0.4	0.6			-0.2
"XVIII"			2.7	0.3			0.8
"XIX"			-0.4	0.1			0
"XX"			-0.5	-0.9			0.5
"XXI"			2.7	5.5			14.9
"XXII"			-1.7	-2.4			4.1
"XXIII"			1.3	-1.5			-2.0
"XXIV"			-1.3	1.5			-1.9
"XXV"			-1.0	-1.3			1.3
"XXVI"			-1.1	-0.2			0.2
"XXVII"			5.2	3.7			19.3
"A"			-4.7	-2.6			12.2
"B"			-3.2	-1.3			4.2
"C"			0.1	-6.0			-0.6
"D"			-3.3	-4.5			14.9

Correlation of Spatial Perception and Acc. of Movement for all subjects. (Cont

Subject	Spatial Percept.	Acc. of Movement	x	y	x^2	y^2	xy
"E"			-0.8	-2.1			1.7
"F"			-2.9	1.5			-4.4
"G"			0	1.5			0
"H"			-1.5	-1.0			1.5
"I"			1.6	0.3			0.5
"J"			-2.7	-3.7			10.0
"K"			-1.5	-1.1			1.7
"L"			0.2	5.5			1.1
"M"			-2.4	-2.8			6.7
"N"			-2.8	-2.8			7.8
"O"			-0.2	-2.6			0.5
"P"			2.6	1.5			3.9
"Q"			0	-2.5			0
"R"			-1.1	-2.4			2.6
"S"			5.8	10.0			58.0
"T"			-2.7	-0.3			0.8
"U"			-3.9	-4.2			16.4
"V"			-2.8	-0.6			1.7
"W"			-0.6	6.0			-3.6
"X"			-1.8	-1.2			2.2
"Y"			-1.5	0.6			-0.9
"Z"			-1.2	-2.2			2.6
"a"			0.7	3.8			2.7
"b"			-0.2	-2.8			0.6
"c"			-0.9	2.5			-2.3
"d"			4.4	-1.1			-4.8
"1"			0.6	1.3			0.8
"2"			1.5	-1.4			-2.1
"3"			-1.7	-2.5			4.3
"4"			-0.3	-1.1			0.3
"5"			-2.4	-2.7			6.5

Correlation of Spatial Perception and Acc. of Movement for all subjects (Cont.)

Subject	Spatial Percept.	Acc. of Movement	x	y	x^2	y^2	xy
"6"			3.3	-0.5			-1.7
"7"			2.2	1.2			2.6
"8"			-1.9	-0.7			1.3
"9"			-3.2	-0.4			1.3
"10"			2.3	3.3			7.6
"11"			-0.9	1.4			-1.3
"12"			1.0	-0.2			-0.2
"13"			-2.9	0			0
"14"			-3.5	-0.9			3.2
"15"			0.3	1.9			1.1
"16"			0.9	1.7			1.5
"17"			4.2	0.3			1.3
"18"			-0.9	-4.1			3.7
"19"			0.2	2.9			0.6
"20"			-3.2	1.2			-3.8
"21"			-3.5	-2.8			10.1
"22"			0.4	-0.7			-0.3
"23"			4.5	-2.9			-13.0
"24"			-1.0	0.2			-0.2
"25"			-1.3	-2.6			3.4
"26"			1.3	-1.4			-1.8
"27"			-4.1	-2.7			11.1
"28"			-1.1	0.5			-0.6
"29"			-1.2	-1.0			1.2
"30"			4.2	-0.3			-1.3
"31"			-2.4	-0.5			1.2
"32"			211	-0.5			-1.1
							Σxy = 315.3
							corrected 313.5

Correlation Coefficient of Spatial Perception and Acc. of Movement for all subjects. (r)

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{313.5}{\sqrt{538.1 \times 669.1}}$$

$$= \frac{313.5}{23.2 \times 28.87}$$

$$= \underline{0.521}$$

Standard error of r $= \frac{1 - r^2}{\sqrt{n}}$ where n is the no. of subjects.

$$= \frac{1 - (0.521)^2}{\sqrt{89}}$$

$$= \frac{1 - 0.26}{9.434}$$

$$= \frac{0.74}{9.434}$$

$$= \underline{0.0785}$$

Probable error of r $= 0.674 \times 0.0785$

$$= \underline{0.053}$$

Correlation pf Drawing with Spatial Perception.

Group 2.

Subject	Drawing	Spatial Perception	x	y	x^2	y^2	xy
"I"	7.6	7.6	1.1	-0.3	1.2	0.1	-0.3
"II"	6.4	7.6	-0.1	-0.3	0	0.1	0
"III"	1.3	3.0	-5.2	-4.9	27.0	24.0	25.5
"IV"	ETC,	etc.	-1.1	0.5	etc.	etc.	-0.4
"V"	aver.	aver.	0.6	1.1	Σx^2	Σy^2	0.7
"VI"	=6.5	=7.9	1.0	5.1	94.6	152.7	5.1
"VII"			1.2	1.1			1.3
"VIII"			-1.5	1.9			2.9
"IX"			-3.5	-2.3			8.1
"X"			1.4	3.7			5.2
"XI"			0.6	0.2			0.1
"XII"			-3.5	-4.2			14.7
"XIII"			-0.8	1.1			-0.9
"XIV"			2.2	1.9			4.2
"XV"			-2.5	-1.5			3.8
"XVI"			1.6	1.7			2.7
"XVII"			0.6	-1.3			-0.8
"XVIII"			2.9	1.8			5.2
"XIX"			0.6	-1.3			-0.8
"XX"			1.1	-1.4			-1.5
"XXI"			2.2	1.8			4.0
"XXII"			-0.3	-2.6			0.8
"XXIII"			0.4	0.4			0.2
"XXIV"			-0.9	-2.2			2.0
"XXV"			-1.0	-1.9			1.9
"XXVI"			0	-2.0			0
"XXVII"			1.4	4.3			6.0
							Σxy = 85.9

Correlation of Drawing and Spatial Perception.

Group 2.

$$\text{Corr. Coefft. } r = \frac{xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$= \frac{85.9}{\sqrt{94.6 \quad 152.7}}$$

$$= \frac{85.9}{120.1}$$

$$= \underline{\underline{0.715}}$$

$$\text{Standard error of } r = \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.715)^2}{\sqrt{27}}$$

$$= \frac{0.489}{5.2}$$

$$= \underline{\underline{0.094}}$$

$$\text{Probable error of } r = 0.674 \times 0.094$$

$$= \underline{\underline{0.063}}$$

Correlation of Drawing and Accuracy of Movement

Group 2.

Subject	Drawing	Accy. of Movement	x	y	x^2	y^2	xy
"I"	7.6	13.8	1.1	-1.2	1.2	1.4	-1.3
"II"	6.4	16.6	-0.1	1.6	0	2.6	-0.2
"III"	1.3	13.5	-5.2	-1.5	27.0	2.3	7.8
"IV"	etc.	etc.	-1.1	-0.8	etc.	etc.	0.9
"V"	aver.	aver.	0.6	-1.2	$\Sigma x^2 =$	$\Sigma y^2 =$	-0.7
"VI"	6.5	15.0	-1.0	5.2	94.6	201.3	5.2
"VII"			1.2	3.6			4.3
"VIII"			-1.5	-3.5			5.3
"IX"			-3.5	-3.9			13.6
"X"			1.4	5.7			8.0
"XI"			0.6	-1.4			-0.8
"XII"			-3.5	-2.5			8.8
"XIII"			-0.8	-1.1			0.8
"XIV"			2.2	3.4			7.5
"XV"			-2.5	-2.8			7.0
"XVI"			1.6	2.6			4.2
"XVII"			0.6	-0.4			-0.2
"XVIII"			2.9	-0.7			-2.0
"XIX"			0.6	-0.9			-0.5
"XX"			1.1	-1.9			-2.0
"XXI"			2.2	4.5			9.9
"XXII"			-0.3	-3.4			1.0
"XXIII"			0.4	-2.5			-1.0
"XXIV"			-0.9	0.5			-0.5
"XXV"			-1.0	-2.3			2.3
"XXVI"			0	-1.2			0
"XXVII"			1.4	2.7			3.8
							$\Sigma xy =$
							81.2

Correlation Coefficient of Drawing and Accuracy of Movement.

Group 2.

$$r = \frac{xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{81.2}{\sqrt{94.6 \times 201.3}}$$

$$= \frac{81.2}{9.72 \times 14.18}$$

$$= \underline{\underline{0.59}}$$

$$\text{Standard error of } r = \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.59)^2}{\sqrt{27}}$$

$$= \frac{0.652}{5.2}$$

$$= \underline{\underline{0.125}}$$

$$\text{Probable error of } r = 0.674 \times 0.125$$

$$= \underline{\underline{0.084}}$$

Correlation of Patternmaking and Spatial Perception.

Group 2.

Subject	Pattern-making	Spatial Perception	x	y	x^2	y^2	xy
"I"	8.9	7.6	1.9	-0.3	3.6	0.1	-0.6
"II"	6.8	7.6	-0.2	-0.3	0	0.1	0.1
"III"	2.4	3.0	-4.6	-4.9	21.2	24.0	22.6
"IV"	etc.	etc.	-2.4	0.4	etc.	etc.	-0.9
"V"	aver.	aver.	-0.6	1.1	$\Sigma x^2 =$	$\Sigma y^2 =$	-0.7
"VI"	7.0	7.9	-1.5	5.1	106.0	152.	77.7
"VII"			2.3	1.1			2.5
"VIII"			-1.8	1.9			-3.4
"IX"			-0.9	-2.3			2.1
"X"			2.8	3.7			10.4
"XI"			-0.5	0.2			-0.1
"XII"			-4.7	-4.2			19.8
"XIII"			2.5	1.1			2.7
"XIV"			2.6	1.9			4.9
"XV"			-1.2	-1.5			1.8
"XVI"			2.2	1.7			3.8
"XVII"			0.7	-1.3			-0.9
"XVIII"			0.8	1.8			1.4
"XIX"			1.0	-1.3			-1.3
"XX"			1.8	-1.4			-2.5
"XXI"			1.9	1.8			3.4
"XXII"			-0.1	-2.6			0.3
"XXIII"			0.6	0.4			0.2
"XXIV"			0.9	-2.2			-2.0
"XXV"			1.3	-1.9			-2.5
"XXVI"			-1.3	-2.0			2.6
"XXVII"			-1.2	4.3			-5.2
							$\Sigma XY =$ 76.6

Correlation Coefficient of patternmaking and Spatial Perception.

Group 2.

$$r = \frac{\Sigma xy'}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{76.6}{\sqrt{106.0 \times 152.7}}$$

$$= \frac{76.6}{10.25 \times 12.36}$$

$$= 0.605$$

$$\text{Standard error of } r = \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.605)^2}{\sqrt{27}}$$

$$= \frac{0.634}{5.2}$$

$$= 0.122$$

$$\text{Probable error of } r = 0.674 \times 0.122$$

$$= 0.082$$

Correlation of Patternmaking and Accuracy of Movement

Group 2.

Subject	Pattern -making	Accy. of Movement	x	y	x^2	y^2	xy
"I"	8.9	13.8	1.9	-1.2	3.6	1.4	-2.3
"II"	6.8	16.6	-0.2	1.6	0	2.6	-0.3
"III"	2.4	13.5	-4.6	-1.5	21.2	2.3	6.9
"IV"	etc.	etc.	-2.4	-0.8	etc.	etc.	1.9
"V"	aver.	aver.	-0.6	-1.2	Σx^2=	Σy^2=	0.7
"VI"	7.0	15.0	1.5	5.2	106.	201.3	7.8
"VII"			2.3	3.6			8.3
"VIII"			-1.8	-3.5			6.3
"IX"			-0.9	-3.9			3.5
"X"			2.8	5.7			16.0
"XI"			-0.5	-1.4			0.7
"XII"			-4.7	-2.5			11.8
"XIII"			2.5	-1.1			-2.8
"XIV"			2.6	3.4			8.8
"XV"			-1.2	-2.8			3.4
"XVI"			2.2	2.6			5.7
"XVII"			0.7	-0.4			-0.3
"XVIII"			0.8	-0.7			-0.6
"XIX"			1.0	-0.9			-0.9
"XX"			1.8	-1.9			-3.4
"XXI"			1.9	4.5			8.6
"XXII"			-0.1	-3.4			0.3
"XXIII"			0.6	-2.5			-1.5
"XXIV"			0.9	0.5			0.5
"XXV"			1.3	-2.3			-3.0
"XXVI"			-1.3	-1.2			1.6
"XXVII"			-1.2	2.7			-3.2
							Σxy =
							74.5

Correlation Coefficient of Patternmaking and Accuracy of Movement.

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{74.5}{\sqrt{106.0 \times 201.3}}$$

$$= \frac{74.5}{10.3 \times 14.18}$$

$$= \underline{0.51}$$

$$\text{Standard error of } r = \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.51)^2}{\sqrt{27}}$$

$$= \frac{1 - 0.260}{5.2}$$

$$= \frac{0.740}{5.2}$$

$$= \underline{0.142}$$

$$\text{Probable error of } r = 0.674 \times 0.142$$

$$= \underline{0.096}$$

Correlation of Workshop Tests and Spatial Perception.

Group 2.

Subject	Workshop	Spatial Perception	x	y	x^2	y^2	xy
"I"	8.9	7.6	2.1	-0.3	4.4	0.1	-0.6
"II"	6.0	7.6	-0.8	-0.3	0.6	0.1	0.2
"III"	3.1	3.0	-3.4	-4.9	11.6	24.0	16.7
"IV"	etc.	etc.	0.6	0.4	etc.	etc.	-0.2
"V"	aver.	aver.	-0.3	1.1	$\Sigma x^2=$ 69.8	$\Sigma y^2=$ 152.7	-0.9
"VI"	6.8	7.9	1.3	5.1			6.1
"VII"			2.1	1.1			2.3
"VIII"			0.8	1.9			1.5
"IX"			0.5	-2.3			-1.2
"X"			1.6	3.7			5.9
"XI"			0.5	0.2			0.1
"XII"			-5.1	-4.2			21.4
"XIII"			0.1	1.1			0.1
"XIV"			0	1.9			0
"XV"			-1.9	-1.5			2.7
"XVI"			-0.8	1.7			1.4
"XVII"			-0.9	-1.3			1.2
"XVIII"			-0.4	1.8			-0.7
"XIX"			0.8	-1.3			-1.0
"XX"			1.8	-1.4			-2.5
"XXI"			2.3	1.8			4.1
"XXII"			0.1	-2.6			-0.3
"XXIII"			1.4	0.4			0.6
"XXIV"			-0.1	-2.2			0.2
"XXV"			-0.3	-1.9			0.6
"XXVI"			0.3	2.0			-0.6
"XXVII"			-0.4	4.3			-1.7
							$\Sigma xy=$ 52.6

Correlation Coefficient of Workshop Tests and Spatial Perception.

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{52.6}{\sqrt{69.8 \times 152.7}}$$

$$= \frac{52.6}{8.35 \quad 12.36}$$

$$= \underline{0.51}$$

$$\text{Standard error of } r = \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.51)^2}{\sqrt{27}}$$

$$= \underline{0.142}$$

Probable error of r = 0.096

Correlation of Workshop Tests and Accuracy of Movement.

Group 2.

Subject	Workshop	Accy. of Movement	x	y	x^2	y^2	xy
"I"	8.9	13.8	2.1	-1.2	4.4	1.4	-2.4
"II"	6.0	16.6	-0.8	1.6	0.6	2.6	-1.3
"III"	3.4	13.5	-3.4	-1.5	11.6	2.3	5.1
"IV"	etc.	etc.	-0.6	-0.8	etc.	etc.	0.5
"V"	aver.	aver.	-0.8	-1.2	$\Sigma x^2=$	$\Sigma y^2=$	1.0
"VI"	6.8	15.0	1.3	5.2	69.8	201.3	6.8
"VII"			2.1	3.6			7.6
"VIII"			0.8	-3.5			-2.8
"IX"			0.5	-3.9			-1.9
"X"			1.6	5.7			9.1
"XI"			0.5	-1.4			-0.7
"XII"			-5.1	-2.5			12.8
"XIII"			0.1	-1.1			-0.1
"XIV"			0	3.4			0
"XV"			-1.8	-2.8			5.1
"XVI"			-0.8	2.6			-2.1
"XVII"			-0.9	-0.4			0.4
"XVIII"			-0.4	-0.7			0.3
"XIX"			0.8	-0.9			-0.7
"XX"			1.8	-1.9			-3.4
"XXI"			2.3	4.5			10.3
"XXII"			0.1	-3.4			-0.3
"XXIII"			1.1	-2.5			-3.5
"XXIV"			-0.1	0.5			-0.1
"XXV"			-0.3	-2.3			0.7
"XXVI"			0.3	-1.2			-0.4
"XXVII"			-0.4	2.7			-1.1
							$\Sigma xy=$
							38.9

Correlation of Workshop Tests and Accuracy of Movement.

Group 2.

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{38.9}{69.8 \times 201.3}$$

$$= \frac{38.9}{8.35 \times 14.18}$$

$$= \underline{0.33}$$

$$\text{Standard error of } r = \frac{1 - r^2}{\sqrt{n}}$$

$$= \frac{1 - (0.33)^2}{\sqrt{27}}$$

$$= \frac{0.891}{5.2}$$

$$= \underline{0.171}$$

$$\text{Probable error of } r = 0.674 \times 0.171$$

$$= \underline{0.115}$$

TABLE 1.

Inter-correlation between the tests. Group 1.

(Decimal points omitted.)

	A.	B.	C.	D.	E.	F.	G.
A.		460	458	390	433	-090	434
B.	460		475	855	497	095	465
C.	458	475		490	388	095	314
D.	390	855	490		460	285	416
E.	433	497	388	460		165	0015
F.	-090	095	095	285	165		111
G.	434	465	314	416	0015	111	

All correlations above 0.434 exceed 4½ P.E.

A. is the Intelligence tests.

B. " " Cube-building test.

C. " " Formboards tests.

D. " " Stripbuilding test.

E. " " Accuracy of Movement tests.(1)

F. " " " " " " (2)

G. " " Engineering Ability.

TABLE 2. Group 1.

	A.	B.	C.	D.
A.		434	496	360
B.	434		478	122
C.	496	478		530
D.	360	122	530	

All correlations above 0.434 exceed 4½ P.E.

A. is the Intelligence tests.

B. " " Engineering Ability.

C. " " Spatial Perception tests grouped together.

D. " " Accuracy of Movement " " "

TABLE 3.

Inter-correlation between the tests. Group 2.

(Decimal points omitted.)

	A.	B.	C.	D.	E.	F.
A.		608	565	586	395	-035
B.	608		674	680	561	006
C.	565	674		670	551	-054
D.	586	680	670		596	-021
E.	395	561	551	596		092
F.	-035	006	-054	-021	092	

All correlations above 0.461 exceed 4½ P.E.

A. is the Intelligence tests.

B. " " Cube-building test.

C. " " Formboards tests.

D. " " Stripbuilding test.

E. " " Accuracy of Movement tests (1).

F " " " " " " (2).

TABLE 4. Group 2.

	A.	B.	C.	D.	E.	F.
A.		510	193	298	655	346
B.	510		720	626	715	590
C.	193	720		815	605	510
D.	298	626	815		510	330
E.	655	715	605	510		680
F.	346	590	510	330	680	

All correlations above 0.461 exceed 4½ P.E.

A. is the Intelligence tests.

B. " " Drawing tests.

C. " " Patternmaking tests.

D. " " Workshop tests.

E. " " Spatial Perception tests.

F. " " Accuracy of Movement tests.

TABLE 5.

Inter-correlation between the tests. Group 2.

(Decimal points omitted.)

	A.	B.	C.	D.
A.		370	655	346
B.	370		630	445
C.	655	630		680
D.	346	445	680	

All correlations above 0.461 exceed 4½ P.E.

A. is the Intelligence tests.

B. " " Engineering Ability tests.

C. " " Spatial Perception tests.

D. " " Accuracy of Movement tests.

TABLE 6. Group 3.

	A.	B.	C.
A.		320	014
B.	320		246
C.	014	246	

All correlations above 0.431 exceed 4½ P.E.

A. is the Intelligence tests.

B. " " Spatial Perception tests.

C. " " Accuracy of Movement tests.

TABLE 7.

Inter-correlation between the tests. Groups 1. and 2.

(Decimal points omitted.)

	A.	B.	C.	D.
A.		419	630	400
B.	419		593	333
C.	630	593		633
D.	400	333	633	

All correlations above 0.353 exceed 4½ P.E.

A. is the Intelligence tests.

B. " " Engineering Ability tests.

C. " " Spatial Perception tests.

D. " " Accuracy of Movement tests.

TABLE 8. Groups 1., 2., and 3.

	A.	B.	C.
A.		518	294
B.	518		521
C.	294	521	

All correlations above 0.293 exceed 4½ P.E.

A. is the Intelligence tests.

B. " " Spatial Perception tests.

C. " " Accuracy of Movement Tests.

GENERAL CONCLUSIONS.

GENERAL CONCLUSIONS.

Consideration of what weighting factors should be used in the tests was given in the light of the preliminary correlations between the various tests.(1)

The Intelligence tests were taken as having been properly weighted when drawn up by the National Institute of Industrial Psychology and they were marked and evaluated in accordance with the "Key" supplied by them.

In the tests of the criteria of Spatial Perception equal weights were given to the Cube-building, Formboard, and Stripbuilding tests. As it has been pointed out that manipulation probably plays about an equal part with spatial perception in the Stripbuilding test,(2) the author has investigated the effect of giving to this test only one half the weight given to the others. On the following page are tables for Group 1., Group 2., and Group 3. Column A_1 is the same as column 5 on page 52-namely the total for Spatial Perception without weighting the stripbuilding test. Column B_1 is the total for Spatial Perception with the stripbuilding test weighted one half. Examination of the two columns shows that the distribution remains practically the same with and without the weighting factor. This is shown also by the standard deviations. For column A_1 the S.D.=2.26 and for column B_1 the S.D. = 2.280 ; The difference made in the correlation coefficient is less than 1%.

Examination of the figures for Groups 2. and 3. reveal similar conditions. Columns A_2 and A_3 are the same as columns 5 on pages 54 and56 respectively, and columns B_2 and B_3 are the totals for Spatial Perception weighted one half. The S.D.

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(1) See page 50 and page 59.

(2) See page45.

Group 1.			Group 2.			Group 3.		
Subject	A_1	B_1	Subject	A_2	B_2	Subject	A_3	B_3
"A"	2.3	2.1	"I"	7.6	7.1	"1"	7.6	7.3
"B"	3.8	3.5	"II"	7.6	7.6	"2"	8.5	8.6
"C"	7.1	6.9	"III"	3.0	2.8	"3"	5.3	5.0
"D"	3.7	3.5	"IV"	8.3	8.4	"4"	6.7	6.5
"E"	6.2	5.6	"V"	9.0	8.4	"5"	4.6	4,3
"F"	4.1	3.8	"VI"	13.0	13.3	"6"	10.3	10.3
"G"	7.0	6.4	"VII"	9.0	9.0	"7"	9.2	9.0
"H"	5.5	5.2	"VIII"	9.8	10.1	"8"	5.1	4.6
"I"	8.6	8.4	"IX"	5.6	5.3	"9"	3.8	3.7
"J"	4.3	4.2	"X"	11.6	11.3	"10"	9.3	9.0
"K"	5.5	5.4	"XI"	8.1	7.9	"11"	6.1	5.9
"L"	7.2	7.0	"XII"	3.7	3.4	"12"	8.0	7.7
"M"	4.6	4.1	"XIII"	9.0	8.6	"13"	4.1	3.5
"N"	4.2	4.2	"XIV"	9.8	9.6	"14"	3.5	3.3
"O"	6.8	6.5	"XV"	6.4	6,2	"15"	7.6	7.1
"P"	9.6	9.5	"XVI"	9.6	9.4	"16"	7.9	7.3
"Q"	7.0	6.8	"XVII"	6.6	6.1	"17"	11.2	11.0
"R"	5.9	5.5	"XVIII"	9,7	9,7	"18"	6.1	5.9
"S"	12.8	12.8	"XIX"	6.6	6.5	"19"	7.2	6.9
"T"	4.3	4.1	"XX"	6.5	5.9	"20"	3.8	3.6
"U"	3.1	2.8	"XXI"	9.7	9.4	"21"	3.4	3.3
"V"	4.2	4.0	"XXII"	5.3	4.7	"22"	7.4	6.9
"W"	6.4	5.8	"XXIII"	8.3	8.0	"23"	11.5	11.0
"X"	5.2	5.2	"XXIV"	5.7	5.4	"24"	6.0	5.5
"Y"	5.5	5.0	"XXV"	6.0	5.8	"25"	5.7	5.6
"Z"	5.8	5.6	"XXVI"	5.9	5.3	"26"	8.3	8.0
"a"	6.8	6.6	"XXVII"	12.2	12.3	"27"	2.9	2.6
"b"	6.8	6.4				"28"	5.9	5.7
"c"	6.1	5.6				"29"	5.8	5.4
"d"	11.4	11.2				"30"	11.3	11.1
						"31"	4.6	4.5
						"32"	9.1	8.8

for column A_2 is 2.38 and for column B_2 2.55 which also indicates little alteration in the distribution. For Group 3. the S.D. for column A_3 is 2.38 and for B_3 which is the total with the weighting factor the S.D. is 2.39 the distribution being practically the same. The correlation coefficients affected are shown below.

Group 1.

r of Intelligence and Spatial Perception (page 168) = 0.496
r " " " " " (with weighting)= 0.494
r " Engineering Abil. & " " (page 172) = 0.478
r " " " " " (with weighting) = 0.474
r " Spatial Perception &Acc.of Movement (page176) = 0.530
r " " " " " "(with weighting) = 0.524

Group 2.

r of Intelligence and Spatial Perception (page 180)=0.655
r " " " " " (with weighting)=0.622
r " Eng. Ability and " " (page 184) = 0.630
r " " " " " " (with weighting) = 0.60
r " Spatial Perception and Accy. of Move.(page 188) =,0.680
r " " " " " " (with weighting) = 0.648

Group 3.

r of Intelligence and Spatial Perception (page 190) = 0.320
r " " " " " (with weighting) = 0.318
r " Spatial Perception & Accy. of Movet.(page 194) = 0.246
r " " " " " " (with weighting) = 0.246

In the tests for Accuracy of Movement the second series was influenced by outside factors and the correlation coefficients with the other tests were mostly about zero,[1] but as it seemed to be of the same nature as the tests in the first series the author decided to treat it equally with

(1)(See pages 46 and 59)

the first series.

In the tests for Engineering Ability each of the criteria was given equal weight. Weighting was used in the calculation of the marks given in each of the criteria, the work done in class being given one half the weight of the work done in the term examinations. As the tests were in Drawing, Patternmaking , and Workshop practice, and as these are, in the opinion of the author, all of about equal importance to the engineer engaged particularly on the production side of the profession, it was decided that no great error would be made in using a composite score based on the average obtained in the three criteria .

In selecting the tests for the investigation the author endeavoured to obtain those that consisted of the same measurable quantity. This however is a matter of very great difficulty for however much a series of tests may appear to fulfil this condition the performance of the tests is apt to reveal the presence of other quantities which make difficult the subsequent work of interpreting the results. The tests were subdivided so that generous 'samples' of the performance could be measured and the units of marking were limited as far as possible in order that the reliability of the tests should be as high as possible. The criteria of the tests were as far as possible marked objectively as an examination of the evaluation of the tests will show, in order to eliminate the complications which are apt to be introduced when a subjectively determined scale is used .

Abilities Measured by the Tests. The Intelligence tests were used for the purpose of comparison with the results obtained in the other tests at a later stage, rather than for the purpose of obtaining a measure of the intelligence of the subjects in the investigation. Consisting as they do of Opposites, Analogies, Mixed Sentences, Completing Sentences

and Reasoning, and the scores being added up and resolved into a percentage for the purposes of correlation, it is assumed that there is a general common factor in all these mental tests in order that this method of summing may be justified. This general common factor is Professor Spearman's 'g'. His 'Theory of 'g'is that a person's score at a mental test may always be divided into two parts, one of which is a measure of the extent to which the score depends on 'g', and the other a measure of the extent of its dependence on the 'specific' factors or the conditions affecting the score other than the general common factor. As it was thought that there might be evidence of such factors during the investigation, the intelligence tests were included.

The tests used in the measurement of Spatial perception were cube-building , strip-building,and formboards tests. The cube-building test differs from the strip-building tests and the formboards tests in that it involves three dimensions while the others are in two dimensions only. Consequently it involves the ideational level, the subject requiring to have the 'idea' of the completed cube in his 'mind's eye' and in some cases an image is also present. The formboards tests are two-dimensional, and involve chiefly the perceptual level. Memory of size shape and form is also a factor in this test as the subject requires to look first at the formboard and then at the pieces in order to make the selection of the correct piece to fit the space which has to be filled. The strip-building test is like the formboards tests in that it is in two dimensions. It also involves memory of size and position. The strips are all rectangular however and thus shape is eliminated. The summation of sizes is involved if the subject fills the tray with pairs of strips the sum of whose lengths is equal to the width of the tray, and this

discrimination of size between lengths with only very small differences between them would seem to be the chief determining factor in this test. The difference in shape in the formboards tests is a help in making the selection of the appropriate pieces. The ability measured by the tests of Spatial Perception is therefore the discrimination of differences in size and shape, and the capacity of the subject to comprehend form and depth in space. Memory and imagery may also be constituents in the measurements made.

In the tests for Accuracy of Movement the constituents are complex. In the first series of tests Kinaesthetic sensations and muscle strain are the most important factors. Imagery may also be a factor in some cases. The time taken to move from one point to another in the trial was sometimes used as a means of estimating the movement in the test and this was a further complication which made it difficult to evaluate this test. In the second series co-ordination of hand and eye is the principal factor but unsteadiness of movement probably due to physical conditions in the subjects made it difficult to measure the criterion in the tests. It would seem then that the abilities measured in the Accuracy of Movement tests are first , kinaesthetic sensation and co-ordination of hand and eye, and second, a group of factors which would require other tests to allow the necessary corrections to be made to the results.

The criteria of Engineering Ability which have been adopted were selected as embodying the principal requirements for the workers in the production side of engineering. The Drawing tests are a measure of the abilities required by the designer and draughtsman. The designer (and the draughtsman) must see in his 'mind's eye' the complete reality of the object of which he is to make his drawing; during his work there are

successive alternations from the two-dimension to the three-dimension and back again. Quite apart from the 'technique' and conventions of the drawing, this ability of 'seeing into the solid' is essential for this type of worker. The Pattern-making tests are tests in which the subject creates the solid pattern from the drawings supplied by the draughtsman. He must become familiar with the tools and materials which are required and the abilities measured in these tests are chiefly manual dexterity, together with the capacity to read the drawings and to visualise the finished pattern from the two-dimensional drawing. Morethan this, he is required to see the 'inverse' of the pattern in order that he may form an idea of the mould and build up his pattern in such a way that it can be easily removed from the sand, and at the same time reduce the labour of the moulder and the skill required of him to a minimum. The Workshop tests are such that the subject is provided with the rough solid and is required to transform this into the finished machine in conformity with the original drawings of the designer. The abilities measured in these tests are again to a large extent manual dexterity. Other factors are accuracy of detail, attention, memory of form and size, etc.

It will be seen that the abilities measured by the tests of spatial perception and accuracy of movement are abilities also required in the tests of engineering ability. In the tables of inter-correlation between thetests in Appendix 2., it will be seen that for Group 1. in Table 1. Engineering Ability has correlation coefficients 0.465, 0.314, and 0.416 with the cube-building, formboards, and strip-building tests respectively while Table 2. shows the correlation coefficient of Engineering Ability with the spatial perception tests grouped together to be 0.478. Except 0.314 these coefficients are significant, the P.E.s being 0.089, 0.112, 0.102, and 0.095, respectively giving over 4½ P.E. in each case except 0.314.

The correlation coefficients of Engineering Ability and the Accuracy of Movement tests for the same group, while positive are not significant. Group 2 (Table 5) has a correlation coefficient of 0.63 for Engineering Ability and Spatial Perception and 0.445 for Engineering Ability and the Accuracy of Movement tests, both of which coefficients are significant, the P.E. is being 0.078 and 0.104. Table 4 for Group 2, shows that the correlation coefficients of the subsections of Engineering Ability with the Spatial Perception tests and with the Accuracy of Movement tests are also significant. These are as follows:-Drawing tests with Spatial Perception tests 0.715, Drawing tests with Accuracy of Movement tests 0.590, Patternmaking tests with Spatial Perception tests 0.605, Patternmaking tests with Accuracy of Movement tests 0.510, Workshop tests with Spatial Perception tests 0.510, Workshop tests with Accuracy of Movement tests 0.330. These all exceed 4½ P.E., except the last, whose P.E. is 0.115.
Table 7 shows the Groups 1 and 2 together. The correlation coefficient of Engineering Ability and the Spatial Perception tests is 0.693 ± 0.056 which is significant. That of Engineering Ability and the Accuracy of Movement tests is 0.333 ± 0.079 and the coefficient being just over 3 P.E. it also is significant. The partial correlation coefficients on page 79 also show that the same abilities are being measured in the tests. The partial correlation coefficient $r_{23.14}$ gives the correlation of Engineering Ability and Spatial Perception, (Intelligence and Accuracy of Movement constant). For Groups 1, 2, and 1and2 together $r_{23.14}$ = 0.469 , 0.439 , and 0.435 respectively. The partial correlation coefficients for EngineeringAbility and Accuracy of Movement are 0.246 , -0.015 , and 0.059 respectively for these groups, while the partial correlation coefficients of Spatial Perception and Accuracy of Movement are 0.472 , 0.516 , and 0.510 respectively, thus confirming the correlations shown in the inter-correlation tables.

It is now evident that the tests of Spatial Perception and Accuracy of Movement which have been used in the investigation are tests of factors which are also factors in the tests of the subsections of Engineering Ability. The partial correlation coefficients show that ,in some degree,it is the same factor. The correlation coefficients of Intelligence and Spatial Perception , Intelligence and Accuracy of Movement , and Intelligence and Engineering Ability also indicate the presence of factors common to these tests, although there is not sufficient evidence in the partial correlation coefficients to indicate that they are the same factors. It is therefore probable that in the tests there are three parts ; (1) a part of which evidence is given by the correlation between the Intelligence tests and the other tests , (2) a part common to the tests of Spatial Perception , Accuracy of Movement ,and Engineering Ability, and (3) a part of which there is not sufficient evidence in the tests to indicate the nature , and for which further tests would be necessary.

It appears then that the testsof spatial perception and accuracy of movement should be particularly valuable for the selection of the workers whose particular work is in the initial stages of engineering production. The designer and the draughtsman , the patternmaker and the moulder all require in a marked degree to be able to 'see into the solid' and it is this specific ability that the tests of spatial perception measure. Tool makers , jig makers , smiths and sheet-metal workers are also engaged in work in two and three dimensions and so the tests should be valuable in these departments also. The accuracy of movement tests are tests which should be valuable in the selection of the workers where steadiness (motor control) and coordination of hand and eye are essential, e.g. draughtsmen, hand tool workers in the patternshop , moulders and core-makers in the foundry,etc.

In the Introduction the limits of the investigation were pointed out, and at the outset it was understood that other tests would be required to cover more completely the field of engineering ability. In the discussion of the abilities measured by the tests attention has been drawn to some of the other abilities which are required to make up the complete engineering worker. For example when considering the abilities required by the patternmaker and the moulder mention was made of the necessity of these workers being able to see the reverse of a solid in the 'mind's eye', — by the patternmaker when he has to make the pattern so that it can be withdrawn without injury to the mould, and by the moulder when he has to build up faulty surfaces of the mould (surfaces damaged by the withdrawal of patterns) or when he has to make the mould without the aid of a pattern either from the drawing or from the object itself. Some tests such as mirror drawing or inverse drawing in which the subject would be required to draw the inverse of a given diagram should be used to measure this ability. In the Machine shop there are conditions which make it necessary for the worker to give his attention to certain operations in the presence of other disturbing factors. A 'divided attentions' test should be used to determine the capacity of the worker to concentrate on one piece of work while keeping under notice some other details. The practical tests in the investigation should measure manual dexterity but some tests of motor ability should be used to measure the muscular coordination of the whole body. These tests are chiefly in the category of 'performance' tests, but some tests should also be used to measure the special innate mental qualities required by the engineer. A series of tests devised "to investigate the innate mental constitution , and to obtain tests which would measure the latent power to profit by training" in engineering, is described by Dr John W. Cox, in

his book,"Mechanical Aptitude" (Methuen & Co.Ltd. 1928).
These tests are (1) Mechanical Models.

(2) Mechanical Explanation.

(3) Mechanical Explanation and Completion.

(4) Mechanical Diagrams.

The Mechanical Models test employs a series of mechanical models so devised that the subject could only see the first and last links in the series of mechanical events which occurred when the model was worked(by hand). He was required to indicate by a simple sketch (with the addition of such words as he thought necessary) how the observed movements were brought about. A time limit was set for each model in accordance with its simplicity or otherwise and marks were given for ideas and not for ability to draw. In the 'Mechanical Explanation' test , the subject is presented with a paper containing several mechanical diagrams each of which is accompanied by a written description of it. He is required to answer a set of questions about each diagram which involve the explanation of the way various parts of the depicted mechanism work. 'Mechanical Explanation and Completion' consisted of 8 sub-tests. Six were of the 'explanation' type. In the remaining two the diagrams were incomplete, the problem being to complete the diagram so as to show how some given mechanical arrangement could be brought about.
For the 'Mechanical Diagrams 'test six large diagrams were prepared. Two represented actual objects while the remaining four represented various mechanically connected items such as rods and wheels which although working together constituted no existing object. Each item was lettered and the subjects were required to describe, by referring to these letters, how the mechanism worked. By means of these tests Dr Cox found a group factor which he called 'm'which restricts its range to a special group of mental operations which enter

largely into the technical side of mechanical engineering. He shows that the group factor is not in opposition to the general factor in mental tests but both are needed in engineering.

With the additional tests which have been delineated above being used in conjunction with those used in the investigation, and the whole of the tests, correlated with the criteria of engineering ability which have been used in the investigation, measurements would be obtained which would give a fairly comprehensive estimate of the abilities which are necessary in the 'make up' of the engineer.

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